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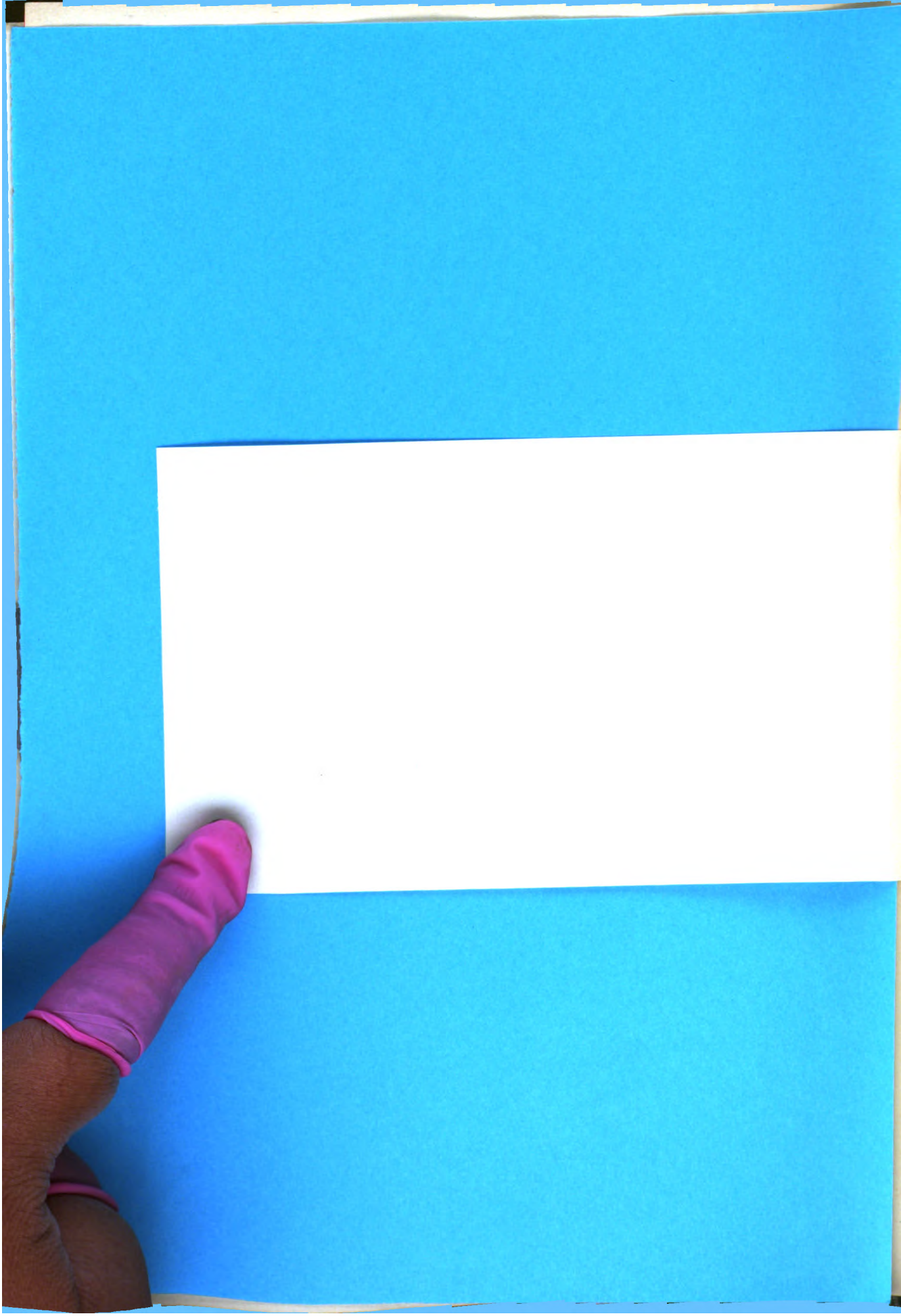
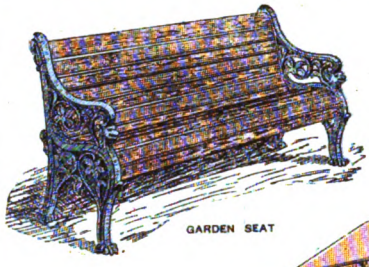
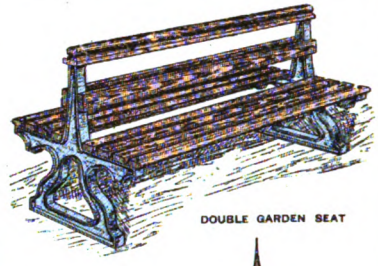


GARDEN FITMENTS.

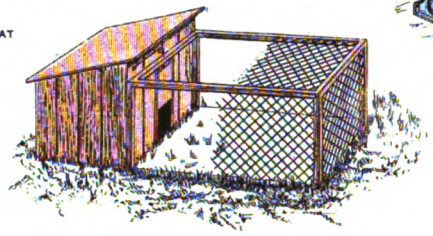


GARDEN SEAT

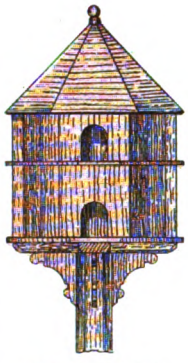
FOLDING GARDEN SEAT



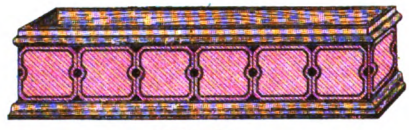
DOUBLE GARDEN SEAT



COLD BROODER WITH RUN



DOVECOTE FOR POLE

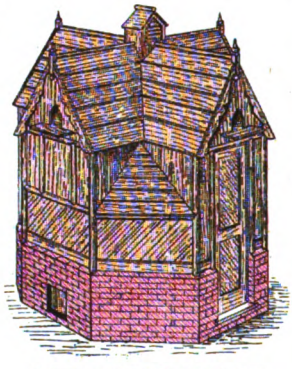


WINDOW BOX

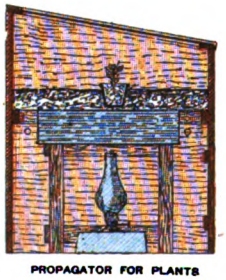
PIGEON HOUSE FOR WALL

LOG TUB
OR FERN STAND

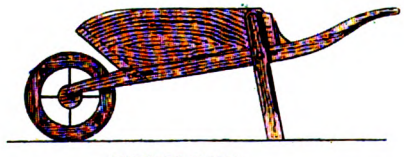
SUMMERHOUSE WITH THATCHED ROOF



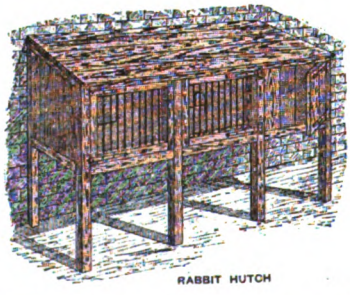
POULTRY HOUSE WITH PIGEON LOFT



PROPAGATOR FOR PLANTS

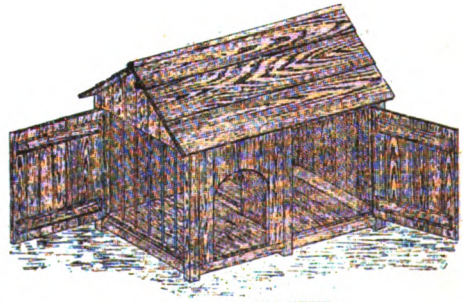


GARDENER'S BARROW



RABBIT HUTCH

PALM STAND MADE FROM TUB



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CYCLOPÆDIA OF MECHANICS

CONTAINING

RECEIPTS, PROCESSES, AND MEMORANDA FOR WORKSHOP USE

BASED ON PERSONAL EXPERIENCE AND EXPERT KNOWLEDGE

PAUL N. HASLUCK

EDITOR-IN-CHIEF

Volume III

FIRST EDITION

CASSELL AND COMPANY, LIMITED

LONDON, PARIS, NEW YORK & MELBOURNE

MCMIV

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LIST OF PLATES (VOL. III.).

SUBJECTS DEALT WITH IN VOLUMES III. AND IV.

(Illustrated Subjects are denoted by Asterisks.)

C

G

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Electric Engraving Machine.—The electric engraving machine illustrated by Fig. 1, and whose parts are shown by Figs. 2 to 6, consists of a light iron frame, 3½ in. in length by 3 in. in height, on which are mounted the two bobbins B (Fig. 1) of an electro-magnet, which actuates a brass arm K D by attracting the armature A, and this in turn moves the vertical shaft E of the steel engraving needle protruding from the tip of the tube F. The frame is of bar iron, ¾ in. wide and ⅜ in. thick. To make it, at one end of a 9-in. piece drill a ⅜-in. hole A (Fig. 2) to take the guide-tube F (Fig. 1); ¾ in. from this drill a ⅜-in. hole to receive the shank of a round-headed screw to hold the magnet core; another similar hole B (Fig. 2) must be drilled 1¼ in. from this for the screw of the other magnet core. The small hole O may be drilled after the frame is bent. At D cut a slot, ⅜ in. long and ¼ in. wide, for the brass arm to work in, and there must be a small transverse hole at E for the pivot pin of this arm; F and H are two ⅛-in. holes bushed with ivory, ebonite, or vulcanised fibre

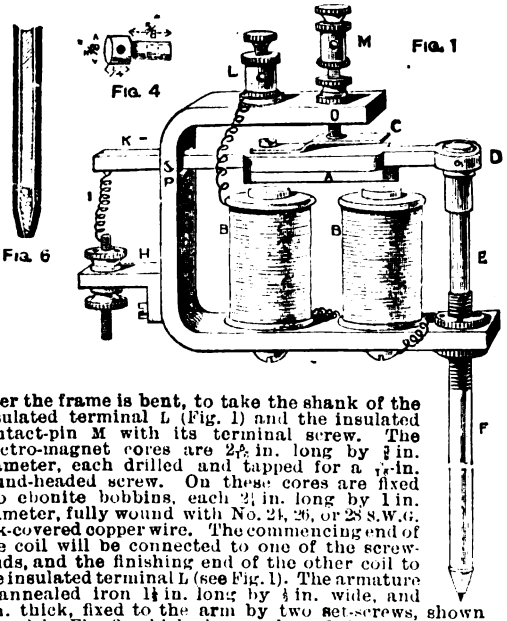


Fig. 1

Fig. 4

Fig. 6

after the frame is bent, to take the shank of the insulated terminal L (Fig. 1) and the insulated contact-pin M with its terminal screw. The electro-magnet cores are 2⅛ in. long by ¾ in. diameter, each drilled and tapped for a ⅛-in. round-headed screw. On these cores are fixed two ebonite bobbins, each 2¼ in. long by 1 in. diameter, fully wound with No. 24, 26, or 28 S.W.G. silk-covered copper wire. The commencing end of one coil will be connected to one of the screw-studs, and the finishing end of the other coil to the insulated terminal L (see Fig. 1). The armature is annealed iron 1½ in. long by ½ in. wide, and ¼ in. thick, fixed to the arm by two set-screws, shown dotted in Fig. 3, which gives a plan of the arm and its fittings. This arm is made of brass 1½ in. long, ¼ in. thick, and shaped as shown. The head A should be ⅜ in. diameter, and have a ⅛-in. hole to receive the head of the engraving needle shown at Fig. 4. A small transverse hole is drilled at B (Fig. 3) to take a steel pin. A steel or German silver contact spring C fitted to the broad part of the arm has a speck of platinum soldered to it at P to engage with the platinum-tipped contact screw M (Fig. 1). This spring is held in place by one of the studs S (Fig. 3), also employed to fix the arm to the armature. At D a small transverse hole ¼ in. in diameter takes the pivot pin P (Fig. 1). At E is a smaller hole for a hook to hold the upper part of the spiral spring I (Fig. 1). The steel engraving needle is made in three parts. Its length is determined by the requirements of the engraver, but the following will be found convenient. Steel head, as shown in Fig. 4; steel shaft (Fig. 5) to screw into the steel head, 7½ in. by ⅛ in.; steel point A (Fig. 5) to screw ⅜ in. into the shaft. Drill and tap a hole in the lower end of the head (Fig. 4) to take the screwed upper end of the shaft (Fig. 5), and in the lower end of the latter drill and tap a hole to take the screwed end of the engraving point A (Fig. 5). This is of hardened steel with a rounded sharp point, a three-cornered point, or a chisel-shaped edge to the tapered point, as may be required. Several points of different shapes may be kept on hand, as they are changed very easily. The head of the needle should not have shake on the supporting steel pin, but when worn loose, it can be easily repaired when made as a separate piece. A little clearance at the front and back of this head permits easy oscillation of the engraving needle working freely in a brass tube or sheath F (Fig. 1) which serves as a guide. The opening at the top should be eased a little, to allow of the slight oscillating motion of the needle. The top part of the tube outside should have a thread cut on it, so that lock-nuts may hold the tube firm and allow it to be taken up to compensate for wear at the tip. It will be seen in

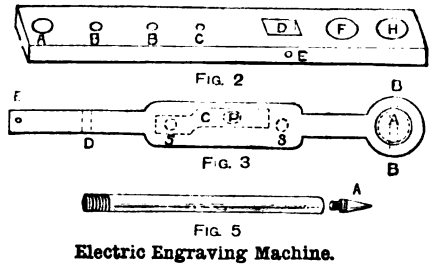


Fig. 2

Fig. 3

Fig. 5

Electric Engraving Machine.

Fig. 6 that this taper tip serves as a guide to the engraving point. When the coils of the electro-magnet are connected by No. 20 or No. 22 S.W.G. wire to a battery of three or more pint bichromate cells, the armature will be attracted, and the engraving point will then protrude from the tip of its sheath, giving a sharp stab to anything held under it. This downward motion of the armature and needle breaks contact at O (Fig. 1), and intercepts the battery current through the coil. To raise the needle ready for another blow a spiral spring I is attached one end to the projecting part of the arm K, and the other end to an adjusting screw held in the bracket H. The tension of this spring must be just enough to raise the needle and bring the contact spring smartly against the contact screw. This screw forms one of the terminals of the machine, and is insulated from the frame by an ebonite bush. Insulate the other terminal in a like manner. When the machine is connected with the battery it should be held by the needle sheath in the right hand, between the thumb and fingers, as a pen or pencil is held. The point can then be held lightly to trace the pattern on the work, and moved along freely whilst it delivers a series of rapid blows and so engraves the work. Usually the machine is spring-supported from the top of a short metal standard, and the bobbins are enclosed in a light wooden case.

Water-meters.—Two types of water-meters are used. In the "Inferential," water is not actually measured, but the quantity of water passed through the meter is inferred from the number of revolutions made by a fan or turbine, which is the only moving part of the meter. The oldest, and certainly the best of this type of meter, is the Siemens, shown partly in section in Fig. 1. The water passes from the top chamber A through the sleeve B into the centre of the turbine C, which is of the Whitelaw type. The channels in the turbine are of a spiral form, with a gradually converging area, so that the water entering by the spindle slowly increases in velocity to the orifices, and being gradually diverted from a radial to a tangential direction, the outlet passage, and its piston is therefore forced down by the superior pressure above, and thus discharges the contents of the cylinder. At the same time one or both of the other cylinders is having its piston raised, whereby water is drawn in through the passages and the lower part is filled. Thus each lower end of the three cylinders B B B is in due course filled and emptied, one or two pistons always supplying the active force, so that there is no dead point. A fan in the upper part of the valve engages the crank of the crank spindle P, which communicates motion to the recording clockwork. Fig. 5 shows the valve; Fig. 6 shows the vulcanite seating. The valve faces require but little attention, as they soon polish themselves bright and remain quite tight. This meter

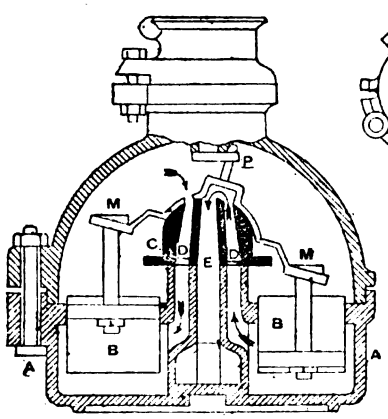


FIG. 2

FIG. 6

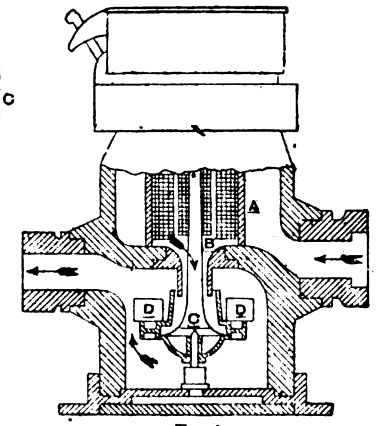


FIG. 1.

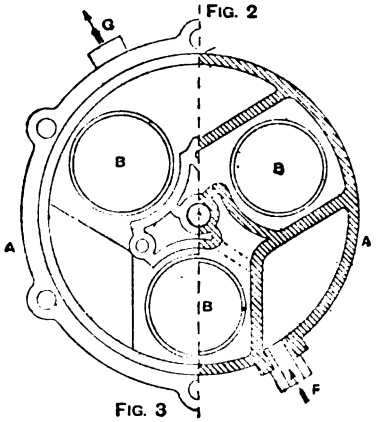


FIG. 3

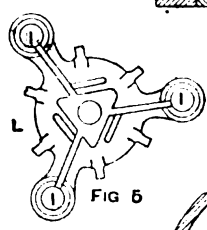


FIG 5

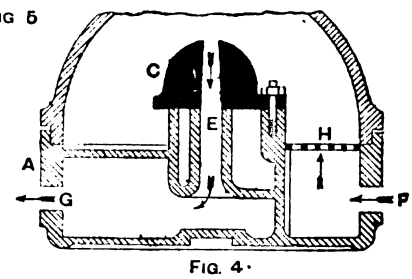


FIG. 4.

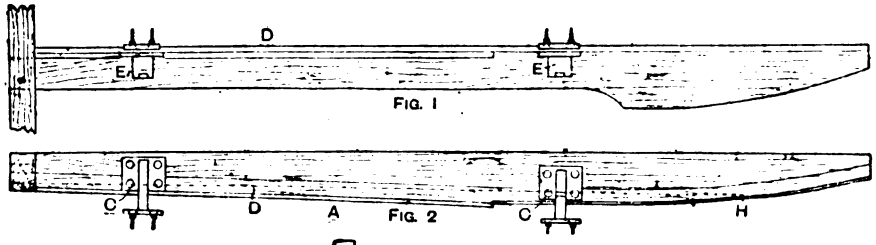
Water-meters.

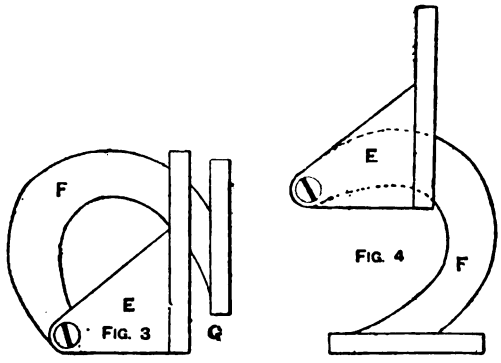
radial pressure set up by centrifugal force exerts a reactive pressure, tending to cause rotation. The fans D D are to prevent undue racing when the water is flowing through at a high velocity, by retarding the rotation of the turbine. The other type of meter is the Positive. The aim in this class of meter is to accurately measure and record the water passing through, hence these meters have each one or more cylinders, with their pistons and valves, which are alternately filled and emptied. Figs. 2 to 6 show sections, plan and detail of the Imperial. This meter consists of the lower portion or body A, containing the cylinder B B B, and the valve seating C, with its three ports and passages D D D communicating with the bottom of the cylinders; there is also a discharge port and passage E, and inlet and outlet connections F and G, and strainer H. In Fig. 5 L is the valve with its three arms on the ends of which are cup-shaped bushes I I I for receiving the spherically shaped heads of the piston rods M (Fig. 2), and to these are secured the pistons. The water enters the meter as shown by the arrows, passes up through the strainer into the upper portion of the casing, and presses downwards on all the three pistons, and also on the valve. According to the position of this valve, the lower end of each cylinder in succession is communicating with the has only four moving parts, no stuffing-box or springs, and is self-lubricating. The only joint which has to be made is that between the body and the cover.

Rusty Painted Steel Girders.—Painted steel girders that have gone rusty should first have the paint cleaned off with a strong solution of equal parts of caustic soda and quicklime in water. The scale is then scraped off and the girders are painted over several times with American turpentine, to which has been added two per cent. of crude vaseline. The metal should now be given two coats of red lead mixed with equal parts of boiled and raw oil, allowing each coat to thoroughly dry. A less conspicuous colour, such as deep purple oxide or Indian red, may then be applied. The turpentine, being volatile, passes off, leaving a very thin film or layer of vaseline on the surface and in the pores of the metal; this film protects the surface against moisture and allows for the expansion and contraction of the metal under variations of temperature. The drying properties of red lead are but little affected by the vaseline, of which the quantity is very small. If the girders then receive an application of hard outside oak varnish an appearance of durability and finish will be given to the work.

Preparing Cement Dado for Painting.—Of the many methods of treating cement dados before applying the paint, a plan recommended and often adopted is to give the cement two coats of boiled oil and turpentine, mixed in the proportions of 2 parts of oil to 1 part of turpentine. This is well rubbed into the cement work until all suction is stopped. Then apply a coat of white paint made from genuine white lead, mixed with boiled oil 5 parts, oak varnish 2 parts, turpentine 1 part. The work may then be carried on in the usual way, finally finishing off with a coat of good elastic copal varnish.

Hanging Brougham Door.—A method of hanging a brougham door with concealed hinges is here illustrated. Fig. 1 is a side elevation of the hind standing pillar of a brougham, with the wood cut away to show the position of the hinge when fixed into the pillar; Fig. 2 is an elevation of the pillar, showing the shut face where the hinges are let in. The pillars are first boxed down, ready to go together, and a chamfer ¼ in. on both ways is run up the top quarter, as shown at A (Fig. 2), the bottom part of the pillar being taken down for the panel. To get the correct position for letting in the hinges, take them apart by removing the screw (Figs. 3 and 4), and fix them, face side to the pillar, by one screw through each hinge in the position they will occupy, as C (Fig. 2), keeping the outer edge of the top hinge just inside the chamfer line, and the bottom hinge ¼ in. in from the face of the pillar. Hold a straightedge to the outside edges of the hinges to see that they line with each other, strike round them with a marking awl, and let them into the pillar so that the flange of the brass part E (Figs. 1, 3, and 4) is flush with the boxed-out part, as D (Figs. 1 and 2). To get the hinge in place, it is necessary to cut away part of the pillar to let in the brass part E (Figs. 1, 3, and 4). To mark this off correctly, the hinge is placed, face side to the pillar, in the recess made in the pillar; care must be taken to make a good fit, as the hinge tapers very much one way, as shown. When the hinge is flush in its proper position, as E (Fig. 1), put in it at opposite corners two ½-in. No. 8 screws, and fix it down and cut out the recess for the iron part of the hinge to work through, as F (Figs. 3 and 4). This recess is best made by boring with a bit and working out gradually with a chisel, being careful not to cut through the pillar; then put the two parts of the hinge together to see whether the bent portion will work clear and free in the recess, until the hinge is closed, as shown in Fig. 1. To do this correctly is rather difficult, as if too much wood is cut away the pillar is weakened and water can get in. The bottom hinge is let in in a similar manner, and when put in correct the parts that are fixed to the door pillar should lie perfectly level on their inner face. To fix the hinges on the door, close them as in Fig. 1; hold a straightedge on the outer edge of the iron flap of the inner part of the hinge G (Fig. 3), and with a pencil make a line on the standing pillar (see the dotted lines in Fig. 2); mark the end of the line on the outside of the pillars. Now take out the hinges and place the door pillar in position on the standing pillar; mark off the line at the panel part at the bottom, take the pillar down, and measure the distance of the line from the outside of the pillar at the top. Mark this distance on the door pillar, and draw a straight line to the mark on the bottom H (Fig. 2); this will be the line of the edge of the door hinge G (Fig. 3). Place the hinges in the standing pillar, measure the distance down to the top of the door hinges, and let them on to the door pillar to the line, and measure. To get a door pillar to swing round and open easily, gouge out a portion of the pillar on the boxing out, from the elbow line up to the top hinge, being careful not to cut through to the outer edge.





Hanging Brougham Door.

Soldering Aluminium.—The difficulty in soldering aluminium is caused by the formation of a film of oxide upon the surface of the metal. This film prevents the union of the metals, and when it is broken up and the melted solder is in contact with the aluminium, there is no difficulty in getting a perfect union. Similar conditions seem to be formed to those obtained when using solders of tin alloy on iron; in this case, also, a perfectly clean metallic surface is necessary at the moment when the melted solder is applied, if perfect union is to be secured. Of course, with iron and many other metals, union may be secured for a lengthened time by chemical means—*i.e.* by means of numerous fluxes—but for aluminium every flux that has up to the present time been suggested seems to have failed to keep the metallic surface clean for a sufficiently long period. However, if the aluminium is heated sufficiently to keep in a molten state the tin or tin alloy that is used as a solder and the surface immediately under the molten solder is scraped with a sharp knife or other suitable tool, so that the resisting film is either broken up or removed, union immediately takes place without the use of any flux whatever. Technically, this procedure has "tinned" the aluminium. No difficulty has ever presented itself in soldering by this method aluminium to itself or to other previously "tinned" metals. In regard to the choice of alloys for solder, there is a very wide latitude. As a matter of fact, nearly any metal or alloy which fuses below the melting point of aluminium will make a solder for aluminium, but the most satisfactory results are obtained when no flux is used, fluxes tarnishing the surface. Pure tin may be employed, and, in fact, tin should always be one of the components of the solder. If the latter melts at a low heat, the soldering bolt may be used to manipulate it, and for alloys melting at a higher temperature, a blowpipe will be necessary. A strong solder giving highly satisfactory results is made by mixing any alloy of tin (as ordinary soft solder) 50 parts, silver 25 parts, and aluminium 25 parts. (See also Series I., p. 164.)

Tar Soap.—In making tar soap it will be necessary first to produce an ordinary soda soap by the usual process of boiling, and to incorporate the tar with it previous to running it into the cooling frames. Coal-tar is not much used; wood-tar is more often employed because it mixes better and has a greater antiseptic action. 152 lb. of fat, consisting of tallow, cottonseed oil, and palm oil, should be heated in the boiling pan and the soda lye added to it gradually while it is thoroughly stirred; the first lye used is of about 1·08 sp. gr. (16° Tw.), and the soap is finished by employing a lye of 1·12 sp. gr. (24° Tw.). Altogether the amount of caustic soda used should be 21½ lb. of 77 per cent. caustic dissolved in 20 gal. to 25 gal. of water. After thorough boiling, which will require several hours, and when saponification is complete, common salt is thrown into the pan; this causes the separation of the soap to the surface, while the lye and impurities go to the bottom, to be run off after several hours' settlement by a cock at the bottom of the pan. The soap is again boiled until it is perfectly homogeneous, when about 15 lb. to 20 lb. of tar is stirred in and the soap framed.

Silicate of Soda or Water-glass.—Silicate of soda, sodium combined with silicic acid, is made by heating together in a reverberatory furnace 90 parts of white sand, 50 parts of soda ash, and 1½ parts of charcoal. Another method is to boil ground flint with a strong solution of caustic soda under pressure. It is usually called soda-water glass, because it is similar to glass in composition, but it is soluble in water. Sodium silicate may be obtained in the form of a transparent solid mass like glass, but it is usually sold in the form of a strong syrupy solution.

Fixing Comb Foundation in Beehive.—In a bar-frame beehive, sheets of wax impressed with the bases of cells are fixed in the frames, and on this comb foundation the bees work and draw out the walls of the cells, making the combs ¾ in. thick for rearing a worker brood, and up to 2 in. thick for storing honey. In most frames the top bar is sawn through, as shown at A (Fig. 1), and the foundation is passed through the saw kerf and secured by driving a couple of nails through the bar. Some bars are sawn only half-way through, and the foundation is fixed by means of a wedge. If the wax is fixed to the top bar only and placed in the hive, and it hangs perfectly plumb and conditions are favourable, the bees will set to work and fill the frame with comb, but the weather may be against the production of comb.

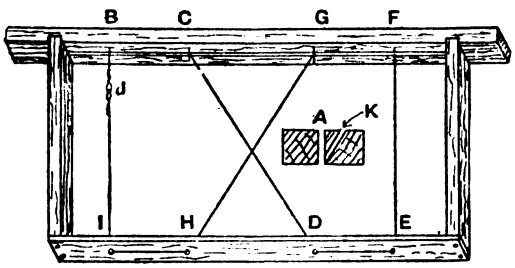


FIG. 1

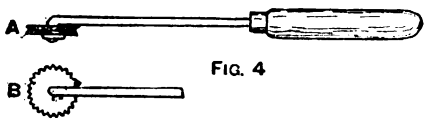


FIG. 4

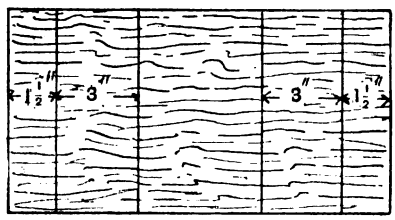


FIG. 2

FIG. 3

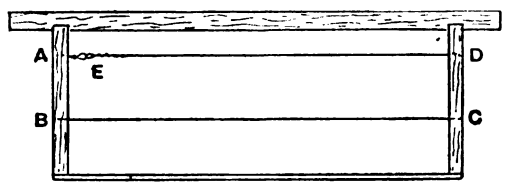


FIG. 5

Fixing Comb Foundation in Beehive.

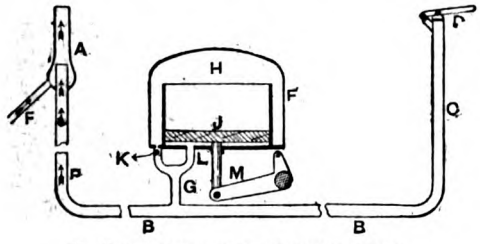
If the bees do not work on the foundation at once, it is liable to warp, which will make the combs crooked, or in hot weather the weight of the bees will sometimes break down the foundation. The best way to overcome these difficulties is to wire the foundation into the frames, No. 30 B.W.G. tinned wire being used for the purpose. This can be obtained from appliance dealers for 6d. a reel. A simple and effective way of wiring a frame is as follows. Cut a piece of board (Fig. 2) to fit loosely inside the frames, and by means of a square mark lines across at 1½ in. and 4½ in. from the ends as shown. Put the board inside a frame and mark the points B to I (Fig. 1) where the lines touch the top and the bottom bars. Now take away the board, and with a bradawl bore fine holes through the centres of the bars at the points marked, making the hole through the top bar, as at K (Fig. 1), to avoid the saw kerf. Next twist a loop on the end of the wire A (Fig. 3), unwind a little more than a yard from the reel, and break by forming a kink, as shown at B (Fig. 3), and pulling with a sharp jerk. Now pass the end of the wire through the hole B (Fig. 1), then through C and so on, finally securing by passing through the loop at J, pulling up fairly tight and twisting the loose end into a loop as shown; afterwards cut off the waste end. Next, slip a sheet of foundation into the top bar groove, and place the frame with the wire uppermost on the board (Fig. 2). Then take a spur imbedder (Fig. 4), heat the wheel on a stove or in a flame to wax-melting heat, place the groove on the wire and run it along, when it will press the wire into the wax, and the heat will cause a coating of wax to cover the wire. The imbedder consists of a piece of wire about ¼ in. in diameter fixed in a wooden handle, the end being bent at right angles to form a journal for a grooved spur wheel about ¾ in. in diameter and ⅛ in. thick. A (Fig. 4) shows the groove in the wheel and B the teeth, which may be easily cut with a small saw file. If half-sheets of foundation are used, the wire may be fixed in the frame, as shown by Fig. 5, the holes being bored at A, B, C, and D, and the wire put through as described for Fig. 1, and finished off with loops at E. It is possible for some sheets of foundation to be wired in the frames for more than three years without the wax warping or twisting in the slightest degree. Where combs are used for extracting, the foundation should always be wired into the frames.

Marbling Drain Pipes.—Ordinary drain pipes can be marbled and made to serve as umbrella stands. First give the pipes a coat of white paint mixed with boiled oil, turps, and driers; the ground coat for the marble should then be applied, and should be mixed with a little japan gold size and varnish to give a smooth surface. The colours for marbling should be obtained in a paste; they are then placed on a palette board and thinned down with turps. A good effect may be obtained by smearing each side of a feather with two or more colours, and drawing the feather across the surface of the pipe; this will blend the colours perfectly. By this method imitations of all kinds of marbles may be obtained. Another method is to place several colours, mixed as before, on a small brush (a sash tool preferred), and by slightly tapping the brush on any hard substance in front of the work to be marbled, a variety of colours are sprinkled on the surface of the work; this gives quite a natural imitation of marble. The colours mostly used in marbling are Indian red, venetian red, middle chrome, yellow ochre, emerald green, Brunswick greens, black, white lead, and raw umber. A variety of shades may be obtained by mixing several of these colours together in variable proportions. After the marbling is completed the pipes should be given two coats of hard oak varnish if dark marble is to be imitated; for light coloured marble, give two coats of French oil varnish.

Changing Device for Stereoscope.—Below is described an arrangement for changing views in a stereoscope. It consists of a box which is placed on the stereoscope, and when one view has been seen the small crank handle is turned and the view rises and drops on the top of the box and the next view is ready for inspection. A box with the top and front open is used. Just inside the edge of the front of the box a flange is fixed to form a shoulder, against which the front picture is tightly pressed in position. The views, mounted on thin card, are pushed forward against this flange by means of a spiral spring fixed to the back of the box, the spring being similar to those used in magazine hand cameras. The changing device consists of a rod passing along the top of the front picture, the rod having three rubber wheels capable of gripping the margins and centre of the picture, so that when the handle is turned the rod is rotated and the picture raised. A strip of brass may be fixed across the top to reach almost to the back edge of the front picture, to prevent the possibility of two pictures rising together. The arrangement works better if the backs of the mounts are glazed and the fronts rough.

Removing Caked Oil from Iron Moulds.—The method of removing caked oil from solid tubular iron moulds is to warm the moulds; then the greater part of the oil will run out; the moulds may then be cleaned with benzoline.

Railway Automatic Vacuum Brakes.—The automatic vacuum brake is used on most of the English railways, and is simple in construction and action. An automatic brake is one that will of itself take action in stopping a train if any portion of it should break away owing to the parting of the couplings, etc. The accompanying diagram, which is not drawn to scale, will explain the working of the automatic vacuum brake. An ejector A, for creating a vacuum throughout the train, is fixed on the engine. Two of these ejectors are used, a small ejector that is sufficiently large to maintain the loss of vacuum due to leakage, and a large ejector for quick action in obtaining the vacuum after applying the brakes or on first coupling up. Connected to the ejector is a 2-in. pipe B B, which is made continuous throughout the train by means of rubber hose pipes and special connections at the end of every carriage, and stand pipes C, with a valve at top and pressure gauges, are fixed in every guard's compartment. Under every carriage one or two brake cylinders E are suspended by means of trunnions and brackets. When a train is coupled up the driver allows steam from the boiler to enter the pipe F, and this steam blowing through the ejector exhausts the air from the pipe B, and by means of the connecting pipe G creates a vacuum in the domed chamber H above the piston J, also below the piston in the brake cylinder. The brake is applied by the driver by means of a valve (not shown on the diagram), by the guard by the lifting of the handle D, or automatically by any breakage of the pipe. Either of these operations allows air to enter the pipe B, causing a ball valve K to rise and close the connection with H in all the brake cylinders, and bringing, through the pipe L, a full atmospheric pressure of about 15 lb. to the square inch on to the bottom of the piston J, which rises and lifts the lever M, which by a system of levers and rods causes cast-iron brake blocks



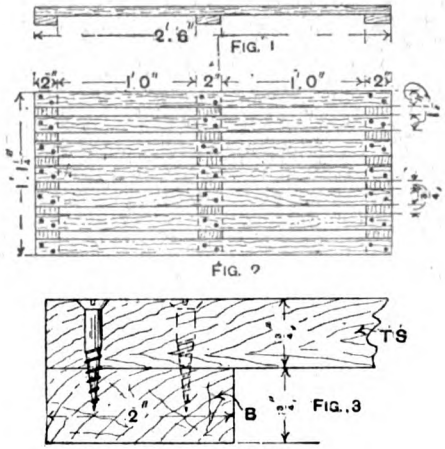
Railway Automatic Vacuum Brake.

to bear on all the wheels. To release the brake, the valves are closed and the vacuum restored by means of the ejector, when the piston J drops by its own weight and releases the blocks from the wheels. Formerly a non-automatic brake was used, in which the application was made by turning on a large ejector and creating a vacuum in a cylinder or a sac, something like a concertina bellows, connected with the levers.

Cementing Metal to Earthenware.—Any of the following cements would fasten metal to earthenware. (1) Mix together 1 pt. of milk and 1 pt. of vinegar. After a time remove the curds. Mix in sifted quicklime until a thick paste is made; it is then ready for use. (2) Mix alum and plaster-of-Paris in hot water to form a thick paste. (3) Boil together 3 parts of resin, 1 part of caustic soda, and 5 parts of water. This will make a soapy liquid. Add half its weight of plaster-of-Paris. (4) Mix sifted quicklime to a paste with blood (obtained from a butcher). This must be used at once, as it hardens quickly. (5) White-lead, red-lead, and boiled linseed oil mixed to a thick paste. This, however, dries slowly, and may be a week or two before it is hard.

Nickel.—Nickel (symbol Ni, atomic weight 58·6, melting point about 2,700° F.) is a white, malleable, ductile, and tenacious metal capable of receiving a silver polish. It resembles iron in some respects, being magnetic, weldable, and being influenced by the presence of carbon, which lowers its melting point; this, in pure nickel, is but little below that of iron. Nickel is not readily oxidised by an ordinary atmosphere, but oxidation takes place when the metal is heated. It is but little affected by most acids, but is easily dissolved by nitric acid. Cast nickel has a specific gravity of 8·357, whilst that of rolled nickel is 8·729. Nickel has its most useful application in the formation of alloys, the chief of these being German silver or nickel silver. Another important use is as a rustless coating for steel and other metals. The principal nickel ores are: Smaltine or smaltite, from which smalts, zaffre, and cobalts are obtained; this, after calcination, yields nickel speiss, a yellowish white and brittle combination of nickel, arsenic, sulphur, iron, etc.; kupfer nickel (copper nickel), which is copper-coloured and has a metallic lustre; nickel pyrites, which is a brassy-looking ore; millerite (hair pyrites) and pyrrholite (magnetic pyrites), which are sulphides of nickel; garnierite, which is a hydrous silicate of iron, magnesia, etc., and is of an apple-green colour. The wet method of extracting the nickel from the ore, as largely adopted, is as follows. The ore is ground, and arsenic and sulphur are removed from it by calcination; then it is made into a solution with hot hydrochloric acid to which bleaching powder is added so as to peroxidise the iron, which falls to the bottom in the form of basic arseniate of iron. Sulphide of copper is precipitated by treatment with sulphuretted hydrogen, the latter then being boiled out of the filtrate. After neutralising the filtrate with lime, bleaching powder is added to precipitate oxide of cobalt, the solution is filtered, and then boiled with milk of lime (an emulsion of calcium hydrate) to precipitate nickel oxide, which is then reduced by making it into a paste with carbon, cutting it into cakes or cubes, and heating, surrounded with charcoal, in crucibles or tubes to a white heat.

Wooden Mat for Washhouse.—In the dimensioned accompanying illustrations Fig. 1 shows the elevation and Fig. 2 the plan of a wooden mat on which to stand to keep the feet dry when washing clothes. It is of red deal slats, with oak or ash under-braces. Square and plane up seven pieces 2 ft. 6 in. by 1½ in. by ¾ in., and



Wooden Mat.

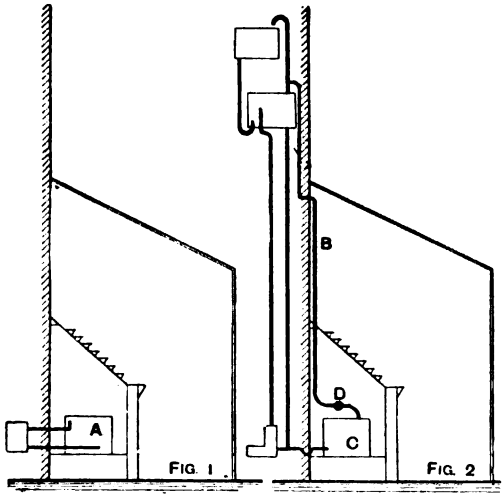
three pieces 1 ft. 1½ in. by 2 in. by ¾ in. The top slats are screwed to the under-braces as shown in Fig. 3, in which B is the cross-section of the under-brace and T S the top slat.

Fitting New Clickspring to Watch.—A new circular clickspring for a three-quarter-plate Geneva watch is bought from material dealers already hardened, tempered, and polished. Sometimes the spring has to be filed a little on the outside edge to fit it to the sink cut in the plate. The thin spring portion generally has to be shortened a little and thinned towards the end to suit the watch in hand. This is done by filing.

Paper Varnish.—To make a good paper varnish, place in any suitable vessel, copper preferred, ¼ gal. of American turpentine, and heat slowly to 100° F.; then add 20 lb. of pale dammar gum. The mixture should be constantly stirred, and the temperature raised till 280° F. is reached; it is then taken off the fire and passed through a fine strainer, and placed in a stoppered bottle to settle and brighten; this generally takes about fourteen days. The varnish is then ready for use. This varnish is sold under the name of crystal paper varnish, and is quite clear and transparent. Some dealers add to it the same quantity of copal varnish and well mix; this makes the varnish more durable, but it is not quite so pale. It is often made by the cold process as follows:—The gum is first ground to a powder, then placed with the turps and agitated by means of a revolving churn driven by steam power, until the gum is thoroughly dissolved. It is then strained and placed in tanks or bottles to brighten. This method does not give such good results as the first process, as the heat causes a thorough amalgamation of the ingredients, and shortens the time of settling before use.

Use of Alum Bath in Photography.—If the temperature of the various solutions is kept fairly even, and unless the plates show a tendency to frill or the prints to blister, the alum bath may be dispensed with; but in very hot or very cold weather it is almost a necessity. The alum solution must be a saturated one, and its exact strength will depend on the temperature. For example, the solubility of potash alum is about 1 in 18 parts of cold water, and, say, its own weight in hot water. The plates do not remain in this bath longer than five minutes. The object of the alum bath is to harden or toughen the gelatine, to render it less soluble and liable to injurious handling, and to cause it to adhere more firmly to its support. The alum bath should be used after fixing, washing well between the operations. If used immediately after developing, and if any developer is carried into the alum bath, a crop of marks will result. Similarly, as hypo is decomposed by alum, it is liable to cause fading if any is carried in the film into the fixing bath.

Heating Greenhouse from Kitchen Boiler.—An arrangement for heating a greenhouse from a kitchen boiler is shown by Fig. 1. In place of the ordinary fire-brick back of a register stove, a square boiler is inserted, and two 1¼-in. pipes are connected to an ordinary 250-gal. galvanised cistern A, placed under the stand as shown. The fire may be in use until about 11.30 p.m. daily,



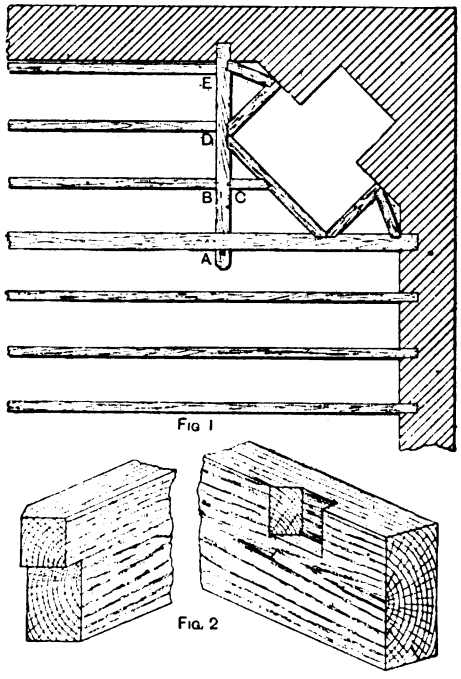
Heating Greenhouse from Kitchen Boiler.

and then is banked up with coke. As the weather gets warmer, a fire-brick back may be placed in front of the boiler. A second arrangement is indicated by Fig. 2, in which a 1¼-in. pipe B is shown brought down from the steam pipe and connected with a 200-gal. tank C; thence it is taken into the return pipe of the boiler. A valve is inserted at D to shut off the greenhouse apparatus when needed. The only difficulty is that after this apparatus has been shut off for the summer, a rusty deposit is stirred up during the first day's re-use, after which the apparatus works as usual.

Using Asbestic Plaster.—Two kinds of asbestic plaster are made, the "rough" employed for the render and float coats, and the "finish" for the setting coat. Asbestic plaster is used in the same way as ordinary plaster. For a porous surface such as brickwork, coke-breeze concrete, etc., the "rough" should be mixed in the proportions of 5 of asbestic to 1 of lime to form the render and float coats. This is larried well together, the lime being run through a very fine sieve into the asbestic and the mixing being done, if possible, while the lime is hot. The plaster can be used after it has been allowed to stand for a few hours. No more water should be added than is necessary to make the plaster work easily. For non-porous surfaces, such as wood, or expanding metal lathing, stone, iron, etc., mix the "rough" in the proportions given above, but gauge into the mixture when ready for use one-third plaster-of-Paris. A ton of asbestic plaster (2,000 lb.), when mixed with lime in the manner indicated, will cover about 80 sq. yd. ¾ in. thick, on a well-laid brick wall. If the plaster is laid on lathing spaced far apart, or on expanded metal, there will be less covering capacity by 10 yd. or 15 yd. to the 2,000 lb. Where outside work is to be done the gauging should be with Portland cement in equal proportions. For inside work, where neither paint nor paper is to be applied for some time, Portland cement can also be used instead of plaster-of-Paris. The "finish" when used for a setting coat is mixed with an equal quantity of lime putty, gauging with it when ready for use from one-third to one-half of plaster-of-Paris. Asbestic plaster is fireproof, and is an excellent non-conductor of heat or cold. Another great advantage is that nails can be driven into the plaster as readily as into wood.

Cementing Horn to Iron.—To cement horn to iron, dissolve shellac in hot methylated spirit till a semi-fluid mass is formed. The iron should be roughened if possible to give a better grip. Both the iron and horn may be warmed slightly, thinly coated with the cement, and then bound tightly together till the cement has set hard. Canada balsam would also be a suitable cement; prepare it as explained on pp. 119 and 139.

Trimming to an Angle Fireplace.—A good method of trimming for a fireplace built in the corner of a bed-



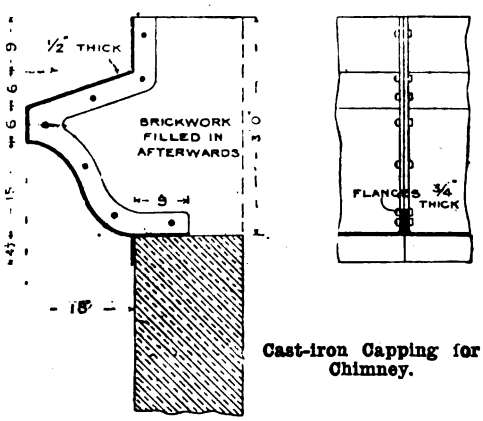
Trimming to an Angle Fireplace.

room is shown in Fig. 1. The trimmer joist and the cross trimmer are framed square, the joint at A is a tusk tenon joint keyed, and the joints at B C D and E are tusk tenon joints. The trimming square to the fireplace is connected to the trimming joist and cross trimmer by notching as shown in Fig. 2.

Gaspipes Filling with Air.—If gas is turned off first at the meter and then at the burners, air will get into the pipes, and cause much annoyance when lighting up. The obvious remedy is to turn off first at the burners. If, however, the gas is first turned off at the burners at night time, and then at the meter, the blowing off of air from the pipes next day proves that the pipes are leaky. Test the pipes during the day at a time when gas is not being consumed and see whether the small pointer on the upper dial of the meter (if a dry one) is moving at all; an hour or so's test is advisable. If the meter is a wet one, see whether the small leaden drum above the index is revolving. If there is a leak the movement will be apparent; then examine the pipe until the leaks are found and stopped, when the meter will stop moving, and it will be unnecessary to shut off the meter at night time. Remember that if the pipes are at all porous the diffusion of the gases will take place, and some of the lighter gas will be passed out into the air, its place being taken by the air.

Bending Lead Pipes.—Small solid-drawn lead pipes should be slightly bent at intervals and the bulged sides dressed in with a soft hornbeam dresser till the desired shape is obtained, a piece of soft carpet, felt, or similar material being laid on the bend to prevent tool marks and to keep the pipe from being unduly bruised. For soil and similar large size lead pipes, the pipe is first slightly bent, which causes the throat to buckle and the sides to bulge. The sides are first driven down by a hornbeam dresser, the throat is then heated and afterwards worked out from the inside with a long-handled dummy. The pipe is repeatedly bent, dressed, and dummied until the bend has acquired the desired angle, and all tool marks are worked out until the bend is perfectly smooth, both inside and outside. A short or knuckle bend near the end of a pipe is made by cutting a small piece out of the side on which the bend is to be made, the opposite side is then buckled round and the throat worked out by a hammer and bent bolt (for a small pipe) and finished with a small hand dummy and dresser for a large pipe. Bends can be made also by loading the pipes with sand, or by using bobbins to make the bends cylindrical, but such devices make the pipe very thin in the heel of the bend, and especially where strength is required. Such methods also point to lack of skill on the part of the plumber.

Cast-iron Capping for Chimney.—The accompanying illustration shows one method of securing a cast-iron

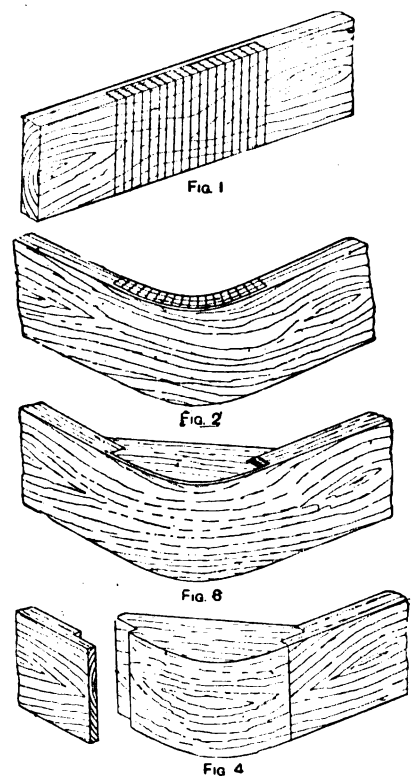


Cast-iron Capping for Chimney.

cap on a factory chimney. The segments, being bolted together, keep in place by their own weight, and may afterwards be filled in with brickwork in continuation of the shaft.

Leather Substitute.—Leather substitute is used chiefly in the manufacture of cheap boots and shoes, mostly for the inside soles and often in the heels. The materials employed for the purpose are leather scraps or cuttings from shoe factories, tanneries, etc., and of late years wood pulp has been utilised for the inferior qualities. The method of procedure is as follows. The scraps are first sorted by girls, who separate the pieces treated with grease and oil from the others. The former are thrown into vats, which contain 95 parts of water and 6 parts of silicate of soda or soluble glass of 35 Baumé, or into a bath containing a proportionate quantity of silicate of soda of 50 Baumé as desired; the scraps are allowed to remain in this solution, which has previously been warmed. The liquor is then run off, and the scraps drained, and then allowed to soak for about an hour in a solution of 6 parts of sulphate of zinc and 500 parts of water. They are then drained off and pressed dry for further treatment. The scraps are next mixed with a paste made from dextrin, gum arabic, and starch; at this stage of the process some makers introduce 5 per cent. of wood pulp that has been through a special process. A solution consisting of 9 parts of water and 2 parts of alum is mixed with the starch paste. After the scraps have been thoroughly mixed in the starch and alum solution, they are taken out and placed in moulds of various depths, and slightly pressed into sheets. They are then removed from the moulds and allowed to soak well in a solution of soda-soap and water, generally 3 of the former to 2 of the latter, after which they are placed in heavy hydraulic presses and finally dried. By this process the grease in the scraps is saponified, and the soluble soap turned into an insoluble one, therefore not requiring the removal of the grease from the waste. This utilises the grease in the form of an insoluble soap, by which process the leather is practically rendered waterproof. The sulphuric acid of the alum combines with the soda of the soap, while the stearic and oleic acids, which are combined in the scraps with the soda, are free to enter into combination with the alum, whilst the tremendous hydraulic pressure completes the combination. The leather is thoroughly impregnated with the alumina, which protects it against moisture and renders it waterproof. When the scraps or waste do not contain grease or oil, the saponification of course is impossible, and instead the leather scraps are mixed with the starch and alum solution and then agitated with the thick paste, being afterwards finished off in much the same way as the others.

Bending Skirting Boards to Curves.—Skirting boards cannot be bent to small curves by ordinary means for practical purposes. The simplest method is to saw-kerf



Bending Skirting Boards to Curves.

the back of the skirting to within about ¼ in. of the face, as indicated at Fig. 1 (the smaller the curve the closer must be the kerfs). The skirting can then be bent to the curve required, as shown at Fig. 2. The best method is shown by Fig. 3; here a veneer and solid block are made and glued together. Frequently for good ordinary work a circular corner for the skirting is prepared out of the solid as shown at Fig. 4.

Jingling Noise in Piano.—If a piano, since being tuned, has acquired a jingling noise as if there is something loose, take the instrument to pieces and carefully examine for any loose object such as a screw, trying the offending notes as each portion is taken apart. If unable to locate the trouble in the instrument itself, get a friend to strike the offending keys whilst search is made around the room. A loose door knob, a gas globe, hatpins in a vase, a loosely fitting glass in a picture frame, are all likely causes by sympathetic vibrations when certain notes are struck. Moving the instrument from its present position, if only a few inches, ofttimes proves a remedy. Also see whether any hitch pins or bridge pins—which should keep the wires an equal distance apart—have slipped, so causing two or more wires to come into contact. Ornaments on top of the piano may cause the jingling noise.

Ink that Disappears with Heat.—The only likely material for a writing ink that would be visible when cold, but would disappear on being heated, is iodide of starch. To prepare this, mix a small quantity of arrowroot or cornflour with a little cold water to form a smooth paste, and pour on this, while stirring, some bo ling water; the material will swell up and dissolve to a clear jelly, but on adding more boiling water a thick fluid will be formed. Allow the fluid to cool, then add a little solution of iodine in potassium iodide, which will form a deep violet-blue colour; too much iodine solution would form a green, which is not desirable. For writing, use a broad pen or camel-hair pencil; allow the writing to dry in the cold, when it will become black. On heating the paper, the iodine will be volatilised, and the writing will disappear. To make the writing reappear, hold the paper for a few minutes over a basin of warm water, and then over a little dry iodine on a saucer.

Technical Terms Used in Levelling.—The accompanying illustration explains better than a mere verbal description the meaning of the various terms used in levelling. The correction for curvature in feet = ⅔ (distance miles)²; the correction for refraction = ⅐ of correction for curvature, so that if the reading, taken to a staff 10 chains

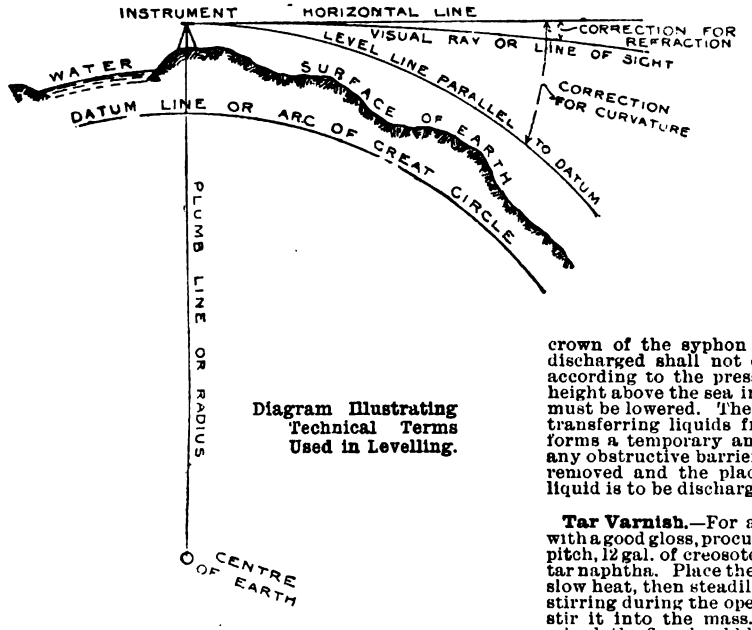
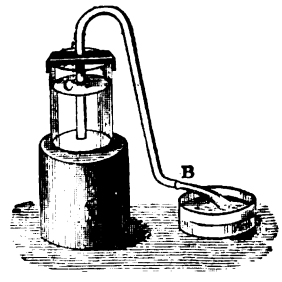


Diagram Illustrating Technical Terms Used in Levelling.

off, be 9·47, and the height of the instrument be 5·10, the true difference of level between the two points will be $9{\cdot}47 - 5{\cdot}10 - \frac{1}{3}\left(\frac{10}{80}\right)^2 \times \frac{6}{7} = 9{\cdot}47 - 5{\cdot}10 - {\cdot}0039 = 4{\cdot}3611$, say 4·36, lower at the staff than at the instrument, the correction being just under $\frac{1}{10}$th ft.

Discharge in Sewers.—In calculating the discharge per minute from glazed pipe sewers of 20 in., 22 in., and 24 in. diameter when running quarter full, half full, and full, together with the different velocities of each, the following information will be useful. The discharge is arrived at by multiplying the sectional area of the liquid flowing through the pipe by the velocity at which the liquid flows. One of the simplest formulæ for calculating the velocity is Eytelwein's, namely, $V = 55\sqrt{2IR}$, where V = velocity in feet per minute, I = fall in feet per mile of sewer, R = hydraulic mean depth in feet. Taking the case of the 24-in. sewer, flowing full, the fall being taken as 1 in 350, which is equivalent to 15 ft. in a mile, and as the hydraulic mean depth for a sewer flowing full is one-fourth the diameter, the formula may be stated as $V = 55\sqrt{30 \times {\cdot}5} = 212{\cdot}85$ ft. per min. The sectional area of the liquid being discharged is evidently the area of a 24-in. circle, or 3·14 sup. ft., and 212·85 × 3·14 = 687 cub. ft. or 4,294 gal. per minute. Taking now the case of the same sewer flowing half full, as the hydraulic mean depth is the same as when flowing full, the calculation remains the same so far as velocity is concerned, and the sectional area of the liquid will be just one-half as much as in the first case. The discharge will therefore be 2,147 gal. per minute. In the case of the same sewer flowing a quarter full, the hydraulic mean depth = diameter × ·147 and the formula becomes $V = 55\sqrt{30 \times {\cdot}294} = 159{\cdot}5$ ft. per minute. The sectional area of the liquid is ·154 d = ·154 × 4 = ·616 sup. ft., and this multiplied by the velocity found above gives 98·25 cub. ft. or 614 gal. as the discharge. The discharges of the 22-in. and 20-in. pipes may be worked out in a similar manner.

Principles of the Syphon.—A syphon is a bent tube whose shape somewhat resembles the reversed "∩," one leg of the tube being longer than the other leg. The syphon works automatically by atmospheric pressure; and when the syphon has been filled with water instead of air, the short leg of the syphon is placed in a vessel of water as shown at C (see illustration), and water flows immediately from the discharge end B of the syphon and continues to flow until the vessel C is empty. The experiment can be tried with a piece of bent gas-pipe, or with a length of indiarubber tubing. Essential conditions of the syphon's efficacy are that the discharge end B shall always be able freely to discharge below the level of the end A, that air shall be excluded from the syphon and replaced with water, and that at about sea-level the height of the



Syphon.

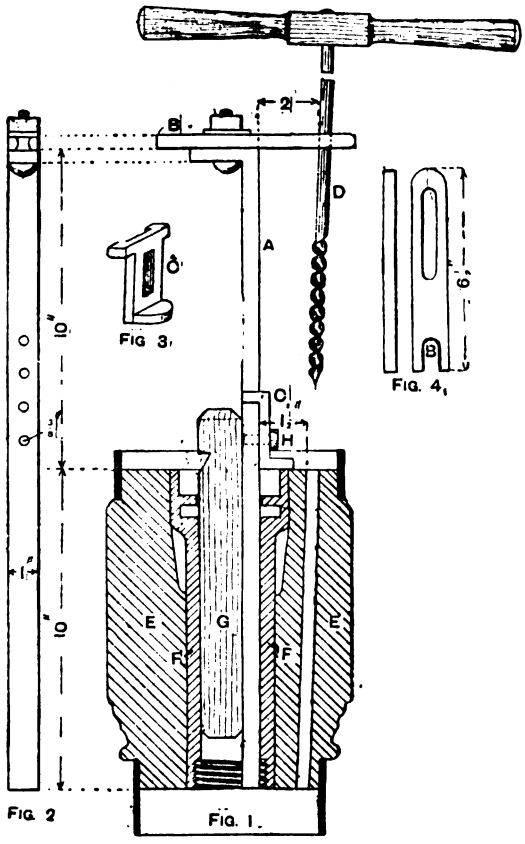
crown of the syphon above the water that is to be discharged shall not exceed about 30 ft. (more or less according to the pressure of the atmosphere). As the height above the sea increases, the crown of the syphon must be lowered. The syphon is used for the purpose of transferring liquids from a high to a lower level, and forms a temporary and easily fixed channel by which any obstructive barrier between the liquid that is to be removed and the place or the vessel into which the liquid is to be discharged is readily surmounted.

Tar Varnish.—For a cheap tar varnish that will dry with a good gloss, procure 3 gal. of coal tar, 1 cwt. of coal-tar pitch, 12 gal. of creosote or light tar oil, and 1 gal. of coal-tar naphtha. Place the tar pitch in a copper and melt at a slow heat, then steadily pour in the creosote, constantly stirring during the operation, then add the tar and well stir it into the mass. After the whole is thoroughly mixed, the fire should be drawn and the mixture allowed to cool down. It is then thinned with coal-tar naphtha to the required consistency. Precautions must be taken to have no light or fire in the vicinity during the latter operation, as the naphtha is highly inflammable. The mixture is then allowed to settle, when it is ready for use. This varnish generally goes by the name of imperial black varnish, and is extensively used by railway and steamship companies. It dries hard with a good gloss. The cost of making varies according to the market prices of the ingredients, but it averages at under 3s. per cwt.

Transferring Prints.—A fluid for transferring printed matter may be made by dissolving 1½ oz. of soap in 1 pt. of water and adding a little turpentine. Shake before using.

Fitting Watch Glasses.—Watch glasses are "snapped" from the front into a shallow groove turned in the bezel. To take a glass out, push it from the back. The knack of fitting watch glasses takes a considerable time to learn, and is the result of constant practice. Beginners always break several glasses. A watch cannot be measured for a glass; glasses have to be fitted by trial until one is found to snap in tight. Glasses that are a little too large can be edged in by means of a fine emery buff (emery paper on wood) applied by hand, working round and round in a circular direction. By makers they are edged on a vertical lathe with emery powder and water on grinding tools of iron, and afterwards polished with rouge on wood or pitch.

Auger Guide for Wheel Borings.—The accompanying illustrations show a guide to be used with the auger D in boring holes through the hub E of a wheel without the trouble of boring from the back and front, to meet in the centre. A (Fig. 1) is a bar of iron 20 in. long by 1 in. by ½ in. (see Fig. 2), with a ⅜-in. hole in the top end. A ⅜-in. bolt secures an adjustable iron arm B (Figs. 1 and 4). When the wedge G (Fig. 1) is driven into the wheel-box, it wedges the bar A firmly against the side of the box F. Four holes are drilled and tapped as shown in Fig. 2, to take a ⅜-in. set-screw H (Fig. 1), this tightening an adjustable fence piece C (Figs. 1 and 3). To use the guide, first ascertain the length of the hub to be bored; then set the fence so that the bar measure is exactly the same as the hub measure, taking from underneath the arm B (Fig. 1) to the face of the fence C. Then drop the bar into the box,

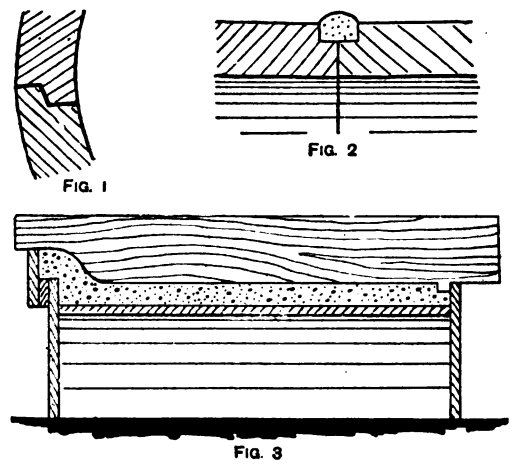


Auger Guide for Wheel Borings.

letting the face of the fence rest on the back of the box level with the back of the hub, the face of the bar being as nearly opposite the print of the hole to be bored as possible. If the hole is to be bored perpendicularly, adjust the arm B so that it measures exactly the same from the face of the bar to the inner edge of the forked end of the arm as a measurement taken from the face of the bar to the inner edge of the print of the hole to be bored at the back of the hub. If the hole is to be bored nearer the centre of the hub at the front than at the back, set out the arm as shown in Fig. 1, where the difference is ½ in. The auger must be lengthened, and care must be taken to keep its shank up to the inner edge of the forked end of the arm B (Fig. 4). The dimensions given suit hubs from 7 in. to 10 in. long, but can be altered to suit all classes of work.

Fixing Loose Mailcart Tyres.—The following instructions on fixing mailcart and perambulator tyres are founded on actual experience. The cement used is a halfpennyworth of pitch; this will usually be more than enough to fix a pair of 2½-in. mailcart tyres all the way round, and a smaller quantity will do for fixing a shorter length, of course. Chip off a piece of pitch and warm it before a fire, holding it in the hands meanwhile. As it softens roll it into a roundish rod about as thin as slate pencil, but do not make it too soft or it will stick unpleasantly to the hands. Insert this rod (or pieces of it) between the tyre and the rim wherever there is a deficiency. Then get a foot length of ⅛ in. or ¼-in. iron wire, with a loop at one end to catch hold of. Make the straight end hot in the fire. It can be nearly red hot, and a small poker will do as well as wire. Melt the pitch thoroughly with the rod, passing it along the wheel rim inside the groove wherein the pitch lies, raising the rubber tyre meanwhile so as not to sear it. Rub the hot iron backwards and forwards over a few inches at a time till the pitch thoroughly melts and then let go the tyre, pressing it firmly in its place. In a few minutes the rubber tyre will be stuck down and will not come out even under rough treatment. Two pokers, one for use whilst the other is heating, will be found of advantage in an all-round-the-rim job. New tyres have been fixed by this method with perfect success. (See also p. 122.)

Concrete Sewer Pipes.—A concrete sewer 39 in. in diameter put in at Cookstown, co. Tyrone (Ireland), was constructed in the following manner. The pipes were socket pipes 3 ft. long, 3 ft. 3 in. internal diameter, and 4½ in. thick. For convenience of making and handling, the pipes were made as half-pipes, that is, each pipe was made with a longitudinal joint at the centre, the top and



Concrete Sewer Pipes.

bottom sections being made separately. This longitudinal joint was rebated as shown in Fig. 1. The top section of the pipe was not socketed, but at each end of the section a rebate was carried round the outer surface, and when the ends of the sections were abutted against each other a filling of Portland cement was put round the joint as shown in Fig. 2. The lower sections were moulded with sockets of the usual shape. Each section was moulded by hand on a wooden mould, which was much like the wooden centering used in building a brick arch, except that the mould was covered with sheet zinc to give a smooth surface and fitted with boards projecting upwards at each end in order to regulate the thickness of concrete applied to the mould. The moulds were placed with their flat faces downwards and the concrete was put on as dry as possible. The outer surface of the pipe was shaped with a strickler, or shaped straightedge, which was drawn by hand over the projecting guides and scraped off the surplus concrete. This operation will be understood by reference to Fig. 3.

Fixing Tiles in Washstand Back.—In fixing about four dozen 3-in. tiles in a wood-framed washstand back, a successful job cannot be made with cement unless the back frame of the washstand is of iron, and is rigid. White lead or glaziers' putty, made into a rather pasty condition with boiled linseed oil, must be used. The background would first have to be thickly painted and the tiles bedded on while the paint was sticky. A good time must be allowed for drying. The best method of fixing tiles on a wood back is to use round-headed screws at the corners. A small chip is pinched off the corner of each tile by a pair of carpenter's pincers or rubbed off on a stone, so that the screws can pass through to the wood and yet the heads will clip the tyres. The above is applicable to fixing tiles in almost any position.

Removing Varnish from Violin.—A violin that has been badly varnished, the resultant appearance being most unsatisfactory, can be treated as follows. Well rub the varnish with flour emery or finest-grade pumicestone powder moistened with water and applied with a woollen cloth. With care, the top coats of varnish may thus be removed without injuring the under coat or spoiling the colour, or by continued rubbings the whole of the varnish can be removed until, with fine-grade glasspaper to smooth down the grain, a clean white surface is left. Care must be taken to avoid excess of water likely to soften the glue joints. When the wood is bare it can be re-varnished.

Using Pit Saws.—The position in which the worker stands when sawing influences to a very large extent the amount of sweep in the tiller of a pit saw. Some sawyers stand close up to the work, others standing almost at arm's length from the work or saw. A man that stands close to the saw requires less sweep in the tiller than a man that works at arm's length from the saw. The closer a man works to the saw, the greater mastery and power has he over the work. Sawyers that work well off from the saw prefer an amount of sweep in the tiller. Others habituate themselves to almost straight tillers. Generally speaking, a 2-in. sweep in a 2-ft. tiller is sufficient. Figs. 1 and 2 represent pit-saw teeth. Many sawyers file the teeth to the shape shown by Fig. 1. This form of tooth may answer fairly well for soft wood of ordinary depth, but for deep timber, and especially the harder kinds, such teeth will cause jarring and bad work. Teeth as in Fig. 2 are the most suitable form. Of course, with all saws, the harder the timber to be sawn

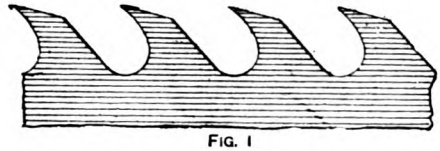


FIG. 1

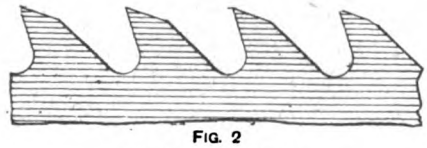


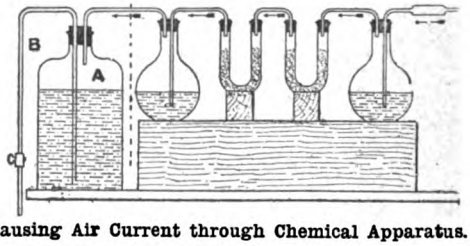
FIG. 2

Teeth of Pit Saws.

the more obtuse the angles in the saw teeth. The mesh of teeth in a saw cutting hard wood should be about $\frac{1}{4}$ in., and for soft wood, $\frac{1}{2}$ in. From No. 15 to No. 16 gauge is very suitable for a saw 6 ft. 6 in. long. The thinner a saw can be worked the less the exertion required. The face and tops of the teeth should be filed with a second-cut topping file, and the bottoms or gullets filed down with a round or half-round file. The teeth should be uniform in length. Teeth $\frac{1}{4}$ in. long will suffice for sawing hard wood, and $\frac{3}{16}$-in. teeth for soft wood. Set should be given to the teeth by means of a hand set, and each tooth should be gauged.

Mercury or Quicksilver.—Mercury, or quicksilver, is a silver-white and lustrous metal liquid at ordinary temperatures, in this latter respect being alone. Its chemical symbol is Hg; its atomic weight 200, and its specific gravity 13·6. At a temperature of −39·44° C., it freezes to a tin-white ductile solid, whilst its boiling point is 350° C. Its high and fairly regular co-efficient of expansion for heat renders it suitable for use in thermometers, barometers, and other scientific instruments. It is not oxidised by the air except when heated to near its boiling point, and this properly affords a means of detecting impurities or adulterations in the form of base metals. Pure mercury runs in spherical drops over any clean, smooth, and slightly inclined surface; if impure, the drops become elongated and sometimes leave dirty stains. Impure mercury, also, may have a dirty film form on its surface if shaken up in a bottle. It volatilises slowly at ordinary temperatures, and very quickly when mixed with hot water; this fact accounts for the pernicious effects of mercury upon those who use it largely in their daily occupations. It unites with most of the metals to form "amalgams," some being liquid and others solid; it amalgamates readily with gold, silver, tin, bismuth, cadmium, lead, and zinc, but not so easily with copper and iron. The chief impurities of the commercial metal are antimony, bismuth, lead, tin, and zinc. A solvent for mercury is nitric acid. Mercury forms part of some important chemical compounds, of which the chief, perhaps, are the pigment vermilion, this being mercuric sulphide (HgS); the medicine, calomel, this being mercurous chloride (Hg_2Cl_2); and the antiseptic and deadly poison, corrosive sublimate, this being mercuric chloride ($HgCl_2$). The chief ore of mercury also is the sulphide, but this raw material is known as cinnabar, the term vermilion being given only to the pure and artificially prepared sulphide. Other ores of mercury are chemical compounds containing one of the following: chlorine, bromine, and iodine. Occasionally the metal occurs native, mechanically mixed with one of its ores, and sometimes it is found amalgamated with silver. Ores of mercury are found in Spain, San Francisco, Austria, and in other places. The chief ore, cinnabar, is brownish-red and fairly soft, and many methods are employed of reducing it. Most of them differ only in detail, the general principle being to heat the ore, so that its sulphur combines with the atmospheric oxygen to form sulphur dioxide (SO_2), whilst the remaining mercury is volatilised and the vapours condensed. The chief impurities, antimony, bismuth, tin, and zinc, are removed by placing the mercury in a retort, adding a quantity of iron filings, and then again distilling the mercury, condensing the vapours in a pipe kept cool in water. In a small way, mercury is purified by distilling in the ordinary laboratory retort; another way is to agitate it well with a concentrated solution of nitrate of mercury at a temperature of about 104° F., the mercury then being washed with distilled water, and, when dry, passed several times through a chamois leather bag. Usually, all that is necessary in cleaning mercury for ordinary purposes is to pass it through the chamois leather bag several times.

Causing Air Current through Chemical Apparatus.—A steady and constant supply of air is to be sent



Causing Air Current through Chemical Apparatus.

through a chemical apparatus illustrated to the right of the dotted line in the accompanying sketch. For the purpose, either a water pump or an aspirator may be used. An aspirator may easily be made from a Winchester quart bottle A (see sketch) by fitting two glass tubes through the cork, one of them short and bent at right angles, the other in the form of a syphon with the longer limb B outside, and fitted either with a tap or with a pinchcock. By sucking over a small quantity of water from the bottle the syphon is caused to work, water flows out of the bottle, and a steady flow of air passes through the apparatus as indicated by the arrows.

Copying Faded Photographic Print.—The chief difficulty in satisfactorily photographing a faded print is the obtaining of sufficient contrast. Not only has the image become lighter, but the paper, which ought to be white, has become yellow, and this yellow showing dark in the print will, with the faded image, conduce to a flat result. The yellowness of the paper may to some extent be counteracted by placing behind the lens a sheet of pale blue glass, which acts as a light filter and obstructs the passage of the yellow rays. The following treatment has been recommended for strengthening the image. Make up the following solutions. (A) Carbonate of lime 4 parts, chloride of lime 1 part, chloride of gold 4 parts, distilled water 400 parts (this is allowed to stand for twenty-four hours before using, is filtered, and must be kept in the dark); (B) Tungstate of soda 1 part, distilled water 50 parts. For use, take 1 part of A and 50 parts of B. Well wash the prints and place them for ten minutes in the above solution (in which the prints should assume a purple colour), then transfer the prints to a solution of 25 parts of B and 1 part of sodium hyposulphite, which will clean the prints. Slow plates or those specially prepared for photo-mechanical work should be employed, and a strong hydroquinone developer, in order to obtain a dense deposit with clear shadows. If the image is still too thin and weak, it may be intensified with mercury and ammonia. The contrast may be still further increased by using a slow developing paper, such as carbon velox. Strong vigorous pictures with good gradation may, with a little skilled handwork, be produced from originals that are almost invisible.

Utilising Old Composition from Printing Rollers.—Whether hardened composition printing rollers can be made use of depends in a great measure on how much they have hardened. If they are small machine rollers, they are scarcely worth troubling about; but if large ones, carefully pare off the outside to a depth of about ¼ in., then cut up the remainder into small pieces and put into the melting pot, adding about a quarter of the weight of new composition if any of the same kind is to hand; if not, add the required amount of black treacle. Keep the mixture well stirred until it is ready for casting in the usual way. If possible, old compo should be used up for hand rollers, replacing the machine rollers with new.

Joints between Roof Purlins and Hip Rafters.—Fig. 1 shows the plan of a hip and the meeting of the hip with two purlins. Fig. 2 is a view of the hip and

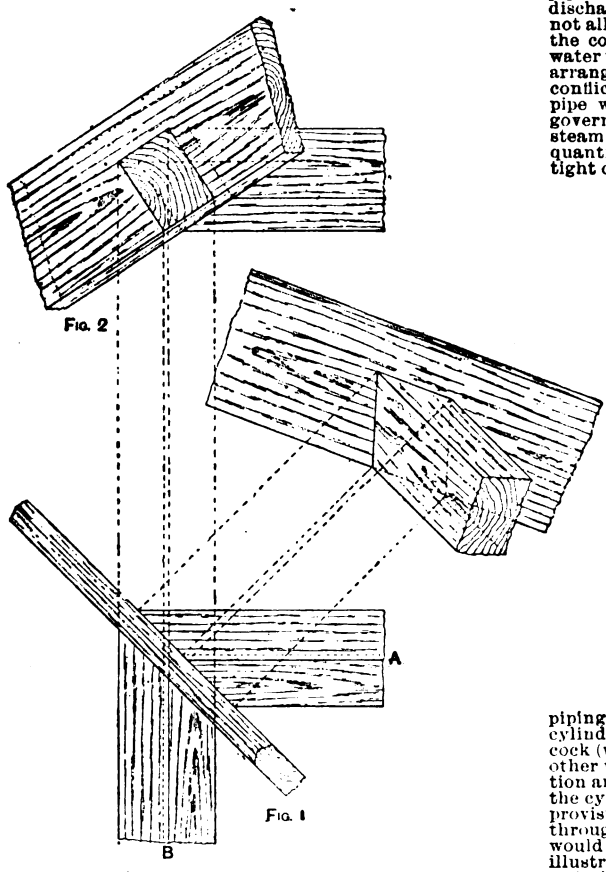


Fig. 2

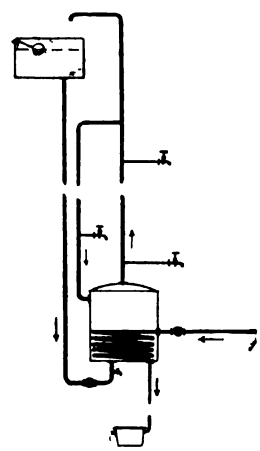
Fig. 1

Joints between Purlins and Hips.

purlins taken parallel to the purlin A (Fig. 1). Fig. 3 is a view of the hip and purlin B (Fig. 2). These views clearly show a general method of abutting the purlins against the hips.

Patent or Enamelled Leather.—For making patent leather or enamelled leather, the skin is prepared in a dry form, more as a russet, and grease must not come in contact with it. While wet it is stretched on a slab, grain side down; while drying it shrinks and toughens. With suitable implements three or four coats of drying varnish are worked into the leather; this varnish is made by boiling 1 gal. of linseed oil with 1 lb. each of white lead and litharge, and adding a portion of chalk or ochre; each coating must be thoroughly dry before the next is applied. Ivory black is then substituted for the chalk or ochre, the varnish thinned with spirit of turpentine, and five more coats are put on thin, not worked in. The leather is next rubbed down with pumice powder, and placed in a room kept at 90° F. and out of the way of all dust. The finishing varnish is prepared by boiling ½ lb. of asphaltum with 10 lb. of the drying oil used in the first stage of the process, and then stirring in 5 lb. of copal varnish and 10 lb. of turpentine. Patent leather is not good till it has been kept at least a month or six weeks; nor should it be kept too long. When finished and set, two skins are put together, face to face, and all air is excluded from between them by rubbing the top one well on the bottom one; then they are rolled up together for packing, the air being kept from them as much as possible. Before separating them, they are warmed gently to prevent cracking.

Heating Water by Steam.—A hot-water supply apparatus designed on the cylinder system and heated by steam is represented in the accompanying illustration. The live steam is brought to the cylinder and connected with a coil inside the cylinder, the pipe of this coil falling all the way to its termination and outlet at the bottom of the cylinder. At the outlet the pipe is continued down to an automatic trap that discharges the condensed water into the drain, but does not allow any steam to escape or go to waste. By giving the coil pipe a fall from the beginning the condensed water travels in the same direction as the steam. This arrangement prevents the steam and water coming in conflict and creating a noise, if nothing worse. A 1-in. pipe will probably do; but the size of the pipe is governed by the length of the coil and the pressure of steam, and the length of the coil is governed by the quantity of water to be heated. The coil must come tight on to the bottom of the cylinder. The hot-water



Apparatus for Heating Water by Steam.

piping from the cylinder and the cold supply to the cylinder are arranged in the usual way, and an emptying cock (with loose key) is placed beneath the cylinder. In other words, the cold supply and the secondary circulation are connected up the same way as if the contents of the cylinders were heated by a hot-water boiler. Special provision for condensing the steam after it has passed through the coil is not required; any such arrangement would entail waste of steam. The method shown in the illustration keeps the steam in the coil (to heat the water) until condensation takes place. Then the condensed water trickles down to the trap.

Removing Rubber Stamp Ink from Paper.—To remove from white paper violet rubber stamp ink, soak the paper in methylated spirit until the ink is dissolved out, then place the paper on blotting paper and allow it to dry.

Heating Water for Bath.—In the absence of a hot water system heated from a range fire, a gas geyser can be used very successfully for heating bath water. If there is no gas, a geyser which burns oil should be obtained. Failing these, a small independent boiler with a hot-water tank could be used; it would burn little fuel, besides using up the cinders of the house. Another kind of stove, and less expensive, is that used for harness rooms. A small box stove has a tank (holding about 10 gal.) fixed on top with a tap in front. This would only need to be stood in front of a chimney and connected by a piece of flue-pipe. Or the washing copper, or a square upright tin vessel on the hot-plate of the range, might be utilised. The vessel should have a lid, with a tap in front; if made only 8 in. wide it does not take up much space. The latter is not used so much as it might be; it makes an excellent auxiliary boiler at any time.

Fitting Hairsprings to Clocks.—To select a suitable clock hairspring, pick out one that looks about the right size and affix it temporarily by pushing the collet on the balance axis. Then suspend the balance by the hairspring, holding the outer end of the spring in a pair of tweezers. Give the balance a rotary motion and count the number of vibrations in ten seconds. Most domestic clocks should make four vibrations per second. If the spring gives a lower number than this, try a stronger one. When one is thus picked out that seems about right, fix it on properly, pin it in the stud, and set the clock going. If the clock loses, shorten the hairspring; if the clock gains, the spring must be changed for a weaker one, or the balance rim must be weighted by adding screws or "tinning" it with lead solder, but the latter does not look well.

Easily Made Handbags.—A general view of an easily made handbag is given by Fig. 1. For the ends of the bag, cut two pieces (Fig. 2) of ¾-in. wood 6 in. by 7½ in. to shape, and then with fine wire nails fasten round them a piece of stout floor oilcloth (one that has a painted back) with the back outside 10½ in. wide by 26 in. long. At one end the corners should be rounded, and before the oilcloth is nailed on it should be bound all round the edge with ½-in. or ¾-in. strong black or coloured tape, or a strip of table oilcloth or American cloth, to prevent the edges fraying; the binding can be stitched on with an ordinary sewing machine if a little care is exercised when the oilcloth is bound. Commence nailing round the edges of the wood ends, beginning at A with the square end and

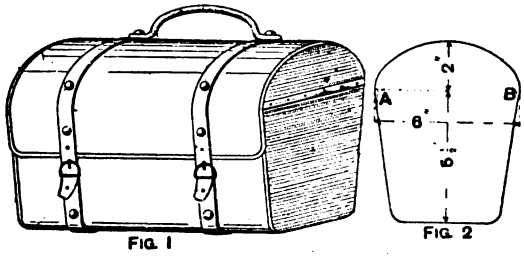
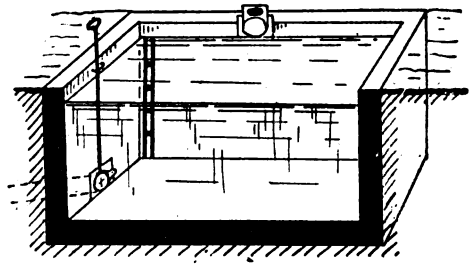


FIG. 1 FIG. 2

Easily Made Handbags.



Measuring Chamber for Sewage.

continuing underneath to B, with just sufficient nails to hold it in place; then on top of the oilcloth from A to B fasten a piece of split cane, using fine wire nails, thus producing a neater finish and securing the oilcloth better; also run a piece of cane across the end, 2 in. from the top, to take off the bareness. The ends should be covered or painted to match the oilcloth. For a handle and fasteners, rivet on a small parcel strap having a leather handle, which is easily secured to the oilcloth with bifurcated rivets. This completes a handy bag which is useful for carrying food, etc., in, and which is easily washed out should anything be upset in it. Other material than oilcloth could be utilised if of sufficient stiffness to retain the shape.

Toning Bromide Prints.—Any shade between red and black may be obtained on bromide paper by the uranium toning bath. The best formula for this toning bath is uranium nitrate 20 gr., potassium ferricyanide 20 gr., acetic acid ½ dr., water 1 oz. Dissolve first the uranium nitrate in half the water and the potassium ferricyanide in the remainder; mix the two together and add the acetic acid. The potassium must be entirely free from the ferro salt. Potassium ferricyanide is a very unstable compound, and is generally superficially coated with a dull yellowish powder or crystals of yellow prussiate of potash or potassium ferrocyanide, which must be removed. This can be done by washing the crystals in hot water for one minute, draining and drying thoroughly on a filter paper, and then weighing. The print, which must be thoroughly fixed and freed from hypo, is evenly wetted by soaking in water and then placed in the toning solution. When the desired tone is obtained the print is transferred to a bath of citric acid of say 1 in 60 for five minutes, and washed for ten minutes in running water. The print must be kept acid throughout, as the uranium ferrocyanide is soluble in alkaline solutions. If the print refuses to change colour or tones unevenly this is a sure sign of imperfect washing or fixing. The prints must not stick together in any of the solutions, no particles of iron rust must be permitted in the washing water, and metal dishes, the rust from which soon finds its way into the solution, must not be used. The uranium toning bath is practically an intensification process, and allowance for this must therefore be made in the printing. Papers can be obtained that give brown tones by development only, by increasing the exposure and using a modified developer. Gravura paper, which is perhaps the best for these effects, is given an exposure of about 6 in. of magnesium ribbon, burnt at a distance of 12 in., and for this paper the developers given below are recommended. Cool to warm sepia: concentrated 1 oz., A. C. solution 50 to 60 minims, water to make 6 oz. Warm brown to red: concentrated 1 oz., A. C. solution ½ oz., water to make 8 oz. Red chalk: concentrated 1 oz., A. C. solution ½ oz., water to make 20 oz. The concentrated solution consists of hydroquinone 50 gr., metol 15 gr., re-crystallised sodium sulphite 1 oz., soda carbonate crystals 1½ oz., potassium bromide 2 gr., water 20 oz. The A. C. solution is ammonium bromide 1 oz., ammonium carbonate 1 oz., water 20 oz. All the chemicals must be pure and in good condition. The warmer or redder the colour desired, the longer must be the exposure. After immersion in the developer for from one to two minutes a pale pink image appears, changing through various shades of red to a greenish tint, showing over-development. If, therefore, the desired colour is reached before the correct depth of tone is obtained the exposure must be increased. In order to obtain the same colour a hard negative requires longer exposure than a soft one. The colour disappears to a slight extent when the print is placed in the fixing bath, but returns on drying.

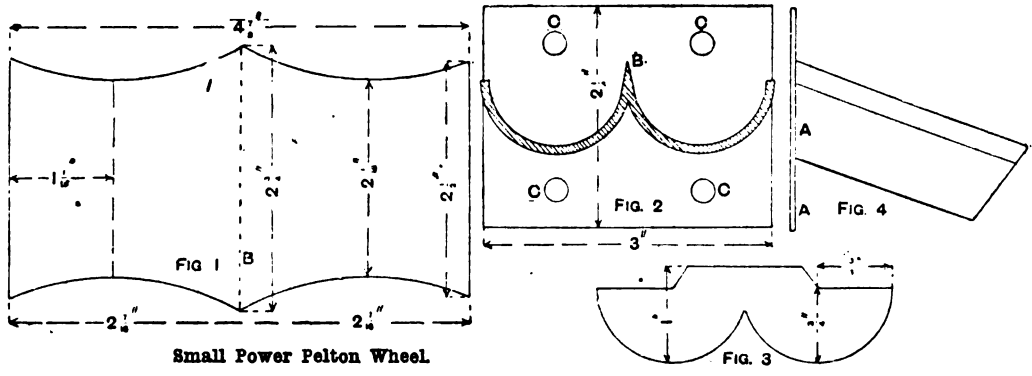
Measuring Chamber for Sewage.—Any tank or chamber of known capacity and convenient size may be used as a measuring chamber for sewage. The capacity of the chamber may be calculated by taking every cubic foot as equivalent to 6¼ gal. of sewage. The measuring chamber shown in the accompanying illustration is 8 ft. long, 4 ft. wide, and 5 ft. from the water level to the bottom, and therefore contains 8 ft. × 4 ft. × 5 ft. = 160 cub. ft., or 1,000 gal. The chamber should be constructed in such a position that the sewage to be measured may be temporarily diverted from its ordinary course and admitted by the sluice shown at the top of the tank. The time that is required to fill the tank will enable the rate of flow to be calculated. A painted gauge staff divided into five equal divisions by marks 1 ft. apart is shown in one corner of the tank; each of the divisions will represent 200 gal. of sewage in the chamber. An outlet valve for emptying the chamber must be provided, and is shown towards the left-hand side of the illustration.

Pointing Wire in Wire Drawing.—Points are made on metal rods and bars that are to be drawn by heating and hammering. When the rods have been reduced to wire, and this is coiled on the rolls for drawing, the points are made by filing the ends on a wood block. When the wire gets too fine to be conveniently filed, the points may be made by stretching the ends over the edge of the draw-plate with a pair of pliers. Or a half turn of the wire is taken on a projecting metal pin, screw, or nail, and the end is stretched to breaking. This will form a point small enough to go through the next and finer hole in the draw-plate. If the wire is hard and brittle from drawing, it must be first softened by heating the end in the flame of a lamp or in a gas jet. The point can then be easily made by stretching the wire.

Calculating Clock Train.—Below is explained how to calculate the length of pendulum for an American clock that has no centre wheel, but only a pinion driven by the main wheel. When this pinion carries the minute hand, the time of revolution of the main wheel must be first found by dividing it by the pinion and calling the result hours. Thus, a main wheel of 100 driving a hand pinion of 10 revolves once in ten hours. Then multiply all the wheels together and divide by all the pinions, leaving out the hand pinion, as mentioned on p. 147. But the result gives the number of beats in ten hours instead of one hour.

Caustic Soda.—Caustic soda (sodium hydrate, NaOH) is manufactured on a very large scale only at the specially arranged alkali works. The raw material is common salt, which is heated in large iron pans with sulphuric acid, producing sulphate of soda or salt cake and hydrochloric acid. The sulphate of soda is mixed in a revolving reverberatory furnace with limestone and coal, producing impure carbonate of soda, etc. The carbonate of soda is dissolved out with hot water, and the solution, evaporated to dryness, leaves a residue of impure carbonate of soda called soda ash. A solution of soda ash is mixed with slaked lime and boiled, producing caustic soda and carbonate of lime. When the latter has settled out the liquor is heated in iron vessels called caustic pots, until the whole of the water has evaporated off and the residue is fused. It is then poured into tins and forms the caustic soda of commerce. The only part of the process that could be carried out on a small scale would be to make a solution of carbonate of soda, boil it with milk of lime, and thus obtain a solution of caustic soda.

Small Power Pelton Wheel.—To make a Pelton water wheel from a belt pulley 21 in. in diameter and of 3-in. face, the buckets (Figs. 1, 2, and 3) must be built up from sheet metal. The back A (Fig. 4), though shown straight, should be curved to fit the pulley. Twenty buckets will be required, evenly spaced round the wheel. Make templates to the dimensions and cut out twenty



Small Power Pelton Wheel.

of each in sheet brass. Fig. 1 is the bottom of the bucket; at B it is bent to form the point as shown in section in Fig. 2. Fig. 3 is the front of the buckets cut out of about No. 20 B.W.G. sheet brass; Fig. 1 should be of No. 24 B.W.G.; ¼-in. holes C (Fig. 2) should be drilled in the back plate for fastening to the pulley. The parts of the buckets then are soldered together. The motor would work up to ½ horse-power providing that sufficient water is available. At a pressure of 45 lb. to the square inch, the water required for ¼ horse-power is about 11·5 gal. per minute; for ½ horse-power, 15 gal.; and for ¾ horse-power, 22·5 gal.; and with a nozzle having a taper of 13½° the corresponding discharge diameters would be ¼ in., ⅜ in. full, and ½ in. full.

Gold-filled Wire Rings.—The term "gold-filled" as used by jewellers is made to include three distinct classes of cheap jewellery. As first introduced, filled-gold articles were made of a thin shell of gold filled with a fusible metal resembling soft solder to give solidity and weight to the articles. The second class of filled-gold articles have metal shells filled with a waxy composition. These shells may be made of thin gold, sometimes of 9-carat quality, or they may be made of a kind of brass named gilding metal electro-gilt to make it appear like gold. Another class of goods has been recently introduced under the same name, and also under the names of rolled-gold and gold-cased articles. The base of these articles is really a kind of gilding metal, an alloy resembling gunmetal. This is cased with gold in several qualities and priced accordingly. Well-made articles of jewellery in this material are now on the market, chiefly in the form of bracelets, chains, brooches, pins, and rings. The lowest-priced articles are made of the lowest-priced gold-cased material, but the material wears yellow throughout, although losing its original gold appearance in a short time. The higher qualities maintain their colour for a considerable period, and all qualities can have their colour restored by electro-gilding. Initial rings are made of these gold-cased wires by twisting the two free ends tightly around the ring with a pair of pliers. Other rings are made in the same way as those of brass or of the usual gold alloys. The joints may be butted or spliced; but perhaps the long spliced joint will be the easiest and best for the amateur jeweller. It must, however, be carefully filed to fit very close, so as to avoid showing the joint, which may be hard soldered with an easy running gold solder if the workman understands using hard solders. However, as the joint has to be made red hot before these solders run, and as the surface of gold-cased wire is made rough by heating to a high temperature, great care must be exercised in hard soldering. An easy running fine jeweller's solder should be used, the flux being killed spirit, or resin only, and the source of heat a fine blowpipe or a jeweller's self-blowing lamp. Joints made in this way can be easily cleaned in hot water. If a harder solder is to be used and borax is employed as the flux, this should be finely ground with water on a slate to a paste and the solder reduced to fine filings and mixed with the borax paste. After the joint is made it should be boiled in a solution of washing soda to loosen the borax glass and aid in cleaning the metal. Both butted and spliced joints may be secured by sweating them together with soft solder, and if this is carefully done the solder can be scarcely seen when the joint is cleaned. After the joint has been filed to shape and closely fitted, the ring is opened a little by twisting the ends aside, and these are then tinned by touching them with a drop of killed spirit and rubbing them on a hot soldering bolt well charged with solder. A very thin film of solder is thus got on the two parts of the joint, which are then closely fitted again, anointed with a mere touch of sweet oil, and then swept with the blowpipe flame. If the wire is overheated and thus discoloured, the colour can be restored by electro-gilding, and this is done in the usual manner with a small quantity of gilding solution heated in an enamelled iron saucepan or in a clean pipkin, and worked with an electric current obtained from a small dry battery.

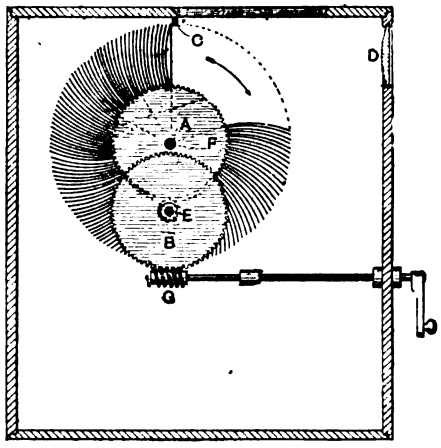
Waterproof Preparation for Brick Walls.—A waterproof preparation for brick walls is made as follows. Procure 10 lb. of resin, 4 lb. of litharge, ¾ gal. of coal-tar naphtha, and 1 pt. of oak varnish. Melt the resin, add the litharge, and allow to remain on the fire for about ten minutes, constantly stirring, then add the oak varnish. The mixture is now removed from the fire, allowed to cool somewhat, and the naphtha slowly stirred in. When cold, thin down to the consistency of varnish with boiled oil. The preparation should be kept in an airtight vessel, as the naphtha, being volatile, will evaporate, leaving the preparation too thick for use. The walls should be first given a coat of boiled oil, followed by a coat of the above preparation. It dries in about six hours, and does not alter the colour of the walls; it is also impervious to rain or moisture.

Violin Strings Breaking.—Violin strings may break not so much because of their quality as of some slight defect in the instrument or in the method of stringing. The hole in the pegs may not be quite true with the slot in the nut, so giving a side as well as a downward strain. If the instrument is fitted with metal pegs, the holes are sometimes left with a sharp cutting edge; they should be slightly countersunk. The bridge may also require attention. The strings are made in two-and-a-half lengths to enable them to be used for half, three quarter, or full-size instruments, and should they break near the tailpiece or below the bridge, the extra piece will ofttimes enable the string to be used again. The brand of strings best suited for the particular instrument in view can be ascertained only by careful observation. Surplus strings should be stowed away in a metal box, obtainable at music shops for a few pence.

Portland Cement Wash.—The usual method employed for binding Portland cement wash is to add to it a strong solution of glue size, which is well stirred into the wash before it is used. The following, also, has been found very effective. Add to ¼ cwt. of the wash ¼ lb. alum dissolved in ¼ gal. water and 2 lb. glue melted in 1 gal. of water; the whole should be thoroughly mixed and applied in the ordinary way. The wall should be well damped before the wash is applied, because the dry wall will absorb the water in the wash, which will then crack and fall off.

Flake White.—The pigment flake white is prepared by grinding pure English white lead in refined poppyseed oil. The Crimnitz white also used by artists is prepared in a similar way by grinding pure zinc oxide or zinc white in refined linseed oil. The proportions are usually white lead 14 lb., refined poppyseed oil 1 pt.; zinc white 14 lb., refined linseed oil 2 pt. These pigments are ground very fine through granite rollers, and are then placed in collapsible lead tubes ready for sale.

Machine for Showing Animated Photographs.—The following is a description of a machine, operated by a winch handle, for showing animated photographs. A is a spindle to which the prints are attached like the leaves of a book. The cards on which the prints are mounted are curved slightly inwards, so that when met

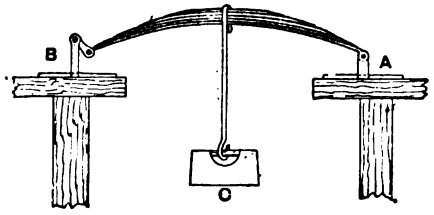


Machine for Showing Animated Photographs.

by the stop C, the prints are straightened out flat for viewing through the convex lens D, which slightly enlarges the picture. As the spindle revolves, the cards one by one fly past the stop in the direction of the arrow, leaving another picture in view. The backs of the cards are of a dead black colour. The spindle must move very slowly; a small pinion E turns the wheel F. Attached to E is a wheel B, actuated by a fine screw G, attached to a rod, which is turned by a handle. Above is a window of ground glass.

Isochromatic Plates in Photography.—When in photographing any coloured subject it is desirable to reproduce the true colour values of the original, isochromatic plates should be employed. Although sensitised plates do not appreciate colour contrast, sensitiveness to light of different colours is a well-established fact. If, for example, an orange cross is painted on a blue background, the orange will look bright and light and the background will appear dark; but if this picture is photographed on an ordinary plate the effect of the original will be reversed, the background appearing light and the cross somewhat darker. Dr. Hermann Vogel was the first to discover that if the plate is treated with certain dyes such as erythrosin, eosin, and cyanin, the sensitiveness of the plate to these colours was increased. True orthochromatism or colour correctness was, however, still impossible in some cases owing to the presence of ultra-violet light, that is, rays of light which, although invisible to the eye, were nevertheless capable of considerably affecting the sensitive plate. As a corrective, a yellow screen that would absorb these violet rays was interposed between the light and the plate. This screen is either a piece of stained glass or a tank filled with a solution of certain dyes, and must occupy a position between the subject and the sensitive plate. The sides of the screen must be perfectly flat, otherwise the course of the rays forming the image will be altered and the focus affected, therefore ordinary glass cannot be used; the glass must be made optically flat. A solution of ammonium picrate (made by neutralising picric acid with ammonia) is a very effective colouring solution. The tint of the screen varies with the subject or according to the amount of ultra-violet light; usually a screen that will prolong the exposure three times is most useful. Ordinary developers such as pyro-soda are used, but each manufacturer issues special formulæ. Generally speaking, isochromatic plates should be worked in a dull ruby light, or the colour to which the plates are least sensitive; but plates that are sensitised fairly evenly throughout the spectrum are now on the market, so that a light specially adapted for the plate must be chosen. A certain shade of green is recommended for Lumière panchromatic plates.

Testing Carriage Springs.—Most of the large railway companies use testing machines at their carriage and waggon works, where they are a necessity in setting up springs to carry a certain weight at a given compass. The best machines work with hydraulic power; in others a steam, screw, or belt action is employed. All spring-makers are supposed to use a steam "scrag" in which every spring is straightened as a test before it leaves the works. Very few spring makers possess a testing and weighing machine; but for carriage makers' and wheelwrights' work, a simpler machine than that shown on p. 199 could be employed, as it is only necessary to test with a moderate weight (say 56 lb.) to tell what the spring will carry when straight. If 56 lb. will straighten a properly tempered spring ¼ in., 112 lb. will straighten it 1 in., 2 cwt. 2 in., and so on. Therefore, to test a spring, bolt on the scroll irons and suspend the spring upside



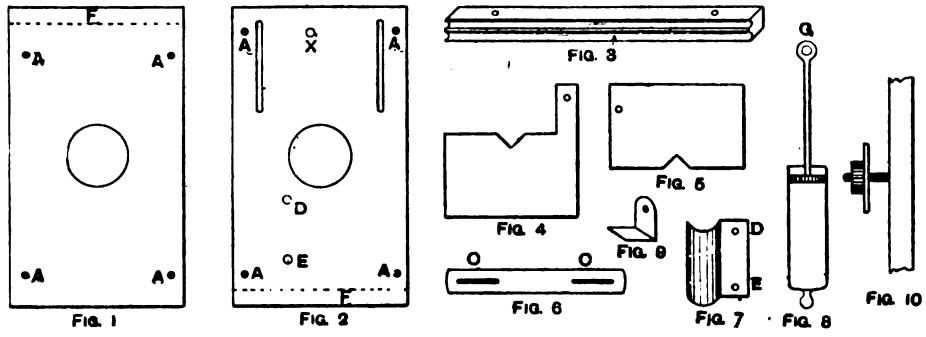
Testing Carriage Springs.

down between two benches, placing the dumb jack on one bench, A in the illustration, and the scroll iron on the other, B. First measure the compass, then suspend a weight C from the centre of the spring, and again measure the compass. If the compass is 4 in. when the spring is unweighted and 3¾ in. when loaded with a 56 lb. weight, the spring will carry 1 cwt. for each ¼ in. loss of compass, and will require 8 cwt. to straighten it. In some engineering books formulæ are given for determining the carrying power of springs, but except when dealing with heavy locomotive springs, these formulæ work out very different from the tests. The following rule is useful for comparing the capacity of two springs of equal length. If T = thickness of plates in $\frac{1}{16}$ in., W = width of plates, N = the number of plates; then $T^2 \times W \times N$ measures the carrying power. For instance, to find the stronger of two springs of equal length and 2 in. wide, one with six ⅛-in. plates or one with eight ¼-in. plates. For the first, $6 \times 6 \times 2 \times 6 = 432$, and for the second, $4 \times 4 \times 2 \times 8 = 256$, so that the first spring is much the stronger: in fact, it takes more than thirteen ¼-in. plates to equal six ⅛-in. plates. A spring rides easiest when loaded till nearly straight, but it is seldom safe to use this fact, as owners are in the habit of overloading vehicles and blaming the maker if the springs fail.

Lining Carts with Vermilion.—Vermilion, owing to its chemical formation reacts with many of the oils, and this prevents the colour from flowing so readily as most colours do; this is one of the many disadvantages of vermilion used as a pigment. Vermilion has now been displaced by the madder reds and lakes, which give better bodied and finer coloured pigments, and are quite permanent and easy of manipulation. Several methods, however, are used for making vermilion flow easily for lining purposes. The usual plan is to grind the pigment under a muller with linseed oil, thinning with turpentine and a small proportion of gold size, whilst some coach painters mix minute quantities of zinc white with the vermilion, and this they claim makes the colour flow more easily. But this method is not recommended, as it destroys the brilliancy of the colour. A method that has of late been adopted by American coach-builders is to grind a little soap with the colours that are found not to flow satisfactorily.

Heating Bath Water.—The best and the most economical method of heating water for a bath, say once a day, is questionable. If the bathroom is immediately over the kitchen, the bath boiler may be placed behind the kitchen fire as the bathroom and the kitchen are so conveniently situated with respect to each other. A saddle boiler and a 2-gal. tank would suffice, and this apparatus would yield a supply of hot water for other purposes during the day. Failing this, a geyser can be recommended provided there is a flue to which the geyser can be connected (the flue must be a good one with a normally constant and active draught). The gas geyser is the more convenient, if gas is in the house; in the absence of gas, good oil geysers may be procured.

Hand Camera See-saw Shutter.—To make a see-saw shutter to fit the hood of a lens 1¼ in. in diameter, cut two plates of thin metal (Figs. 1 and 2) with the perforations shown, and groove two strips of brass like Fig. 3. These strips are fixed to the plates by riveting through the holes A. Now cut two plates like Figs. 4 and 5, and affix brass pins where shown. These pins are made to run very freely in the grooves of Fig. 3. Cut a bar (Fig. 6) with slots C, passing them over the pins. Having fitted these into place, and the brass clip (Fig. 7) for the cylinder at D and E, turn over the extra pieces F from the dotted lines in Figs. 1 and 2. The cylinder and rod shown in Fig. 8 is next made; it must work freely, and



Hand Camera See-saw Shutter.

is held by the clip (Fig. 7) and the loop G attached to the pin shown in Fig. 5. Lastly, the catch (Fig. 9) may be made, and fixed at X (Fig. 2). This catch, which may be turned back when not required, serves to stop the shutter half way, and keep it open. Two screws may be fixed through the back plate (Fig. 1) with thumbnuts, and a plate cut to fit the lens mount; this is shown in Fig. 10. The shutter is only suitable for single lenses, or lenses of small diameter. The rubber tube and pneumatic ball can be purchased at any photographic store.

Wax that Disappears on being Heated.—By mixing beeswax with Venice turpentine is made a modelling wax that will entirely disappear with heat, leaving no residue. The yellow colour of the wax is, however, not a pleasant shade for modelling purposes, and it is customary to tint it with vegetable pigments. A brilliant red may be obtained from sulphide of mercury, which will be entirely evaporated when the wax is melted.

Photographing Stone Memorials, etc.—The implements for photographing stone memorials, etc., are a half-plate camera with rising and sliding front and swing back, lens, camera stand, three double dark slides, ½-plate vulcanite developing tray, three porcelain dishes for fixing, soaking, and alum baths, and one for toning, a minim glass and 2-oz. glass measure, scales for weighing grains, scruples, and drachms, a few printing frames, a spirit level, ruby lamp, and dry plates (ordinary rapidity). The necessary chemicals are:—Pyrogallic acid, 1 oz.; ammonia, 4 oz.; bromide of potassium, 2 oz.; nitric acid, 1 oz.; washing soda, 1 lb.; sulphite of soda, ½ lb.; alum, 1 lb.; hyposulphite of soda, 6 lb.; chloride of gold, 15-gr. tube; acetate of soda, 2 oz.; bichloride of mercury, ½ oz.; and perchloride of iron, 1 oz. These may be purchased without difficulty at any photo dealer's, though there may be some trouble in obtaining the bichloride of mercury, which is very poisonous. Sulphite of soda, and not sulphate, which is useless, must be insisted upon. This must be kept in well-stoppered bottles, as it is converted to sulphate on exposure to air. A rectilinear lens will be most suitable, though, as the objects to be taken are stationary, a doublet lens is not so important, as the defects of a cheap single lens, such as curving straight lines, bad covering power, etc., may be lessened by using a small diaphragm or stop, but this, of course, increases the length of exposure. As, however, it will frequently happen that the space at disposal is confined, a wide-angle lens as well will be required. This must be a good one, and even then should be used only if really unavoidable. The manipulations are: In the dark room, by the aid of light from the ruby lamp, fill the dark slides so that the film side of the plate will be towards the lens when exposed in the camera. In the event of taking very white stones against a dark background, the plates must be backed with non-actinic coloured paste to prevent halation. It is sometimes advisable to erect a temporary background to prevent other stones spoiling the outline. Having erected the camera, focus the stone sharply on the ground-glass screen, taking care that the camera is perfectly level and not tilted in any way, and that the lines are perfectly straight. If it is necessary to tilt, correct by using the swing back. Next insert a stop sufficiently small to correct defects in definition, and put in the dark slide. Cap the lens, draw the shutter, and expose for a length of time that must be learnt by experience. The formula for development of the exposed plates depends upon the particular make of plates used; Cadett's slow plates may be tried with advantage. The maker's formula on the box is usually best. Here is an excellent one, however.

No. 1.	No. 2.
Pyrogallic acid, 1 oz.	Washing soda, 4 oz.
Sulphite of soda, ½ lb.	Water, 80 oz.
Nitric acid, ½ dr.	
Water, 80 oz.	

Use equal quantities of each. Place the plate, film up, in a vulcanite tray, flow over the developer, and rock occasionally. In about a minute the picture will appear. If the contrast is too great, it is under-exposed; add more accelerator (No. 2) and place for a time in a bath of plain water to soak up a little detail. If contrast is insufficient, add a few drops of a 10 per cent. solution of bromide of potassium. When all detail is out, wash and place for a few moments in alum (saturated solution): then transfer to fixing bath (hyposulphite of soda, 6 oz.; water, 1 pt.). When the fixing is complete, the opalescent appearance will have departed from the back; then, after a few moments, wash, return to alum, and finally wash for two hours in constant changes of water. When dry, the negative is printed from by exposure in a printing frame with a piece of sensitised albumen paper (film side in contact with the film of the negative). When printed to the required depth, which may be ascertained by opening *one half* of the frame back and taking care not to move the other half of the paper, trim off the rough edges, wash, and place in a toning bath, consisting of chloride of gold, 2 gr.; acetate of soda, 1 dr.; and water (distilled), 12 oz. Make this a week before using. The prints must be kept moving in the bath until the desired colour is obtained, then wash and transfer to the fixing bath for about ten minutes. After a few hours' washing in thorough changes of water, mount as taste suggests. Of course, there are many other printing processes, but this is the simplest. Various dodges have to be resorted to at times in order to make the lettering on tombstones show up. If the operator is skilful with the brush, the letters may be touched up before photographing. Dabbing parts of the stone with putty has often to be resorted to in order to dull the surface and prevent reflection.

Staining and Polishing Chip Carving.—To stain chip carving a walnut colour mix dry burnt umber or vandyke brown to a thin paste with liquid ammonia, then thin with water. Apply this with a bristle brush, well stabbing the brush into all undercut portions; wipe off the surplus with rag, then rub smartly with a clean shoe brush; the process may be repeated if desired. To get the stain the correct colour, experiment first on odd pieces of wood. When quite dry, brush over with raw linseed oil, then apply two coats of thin spirit varnish; an interval of at least half an hour should elapse between the two applications. When hard, smooth down any roughness with a shoe brush and medium grade pumicestone powder, then brighten up by vigorously rubbing with beeswax and turpentine, or with a polishing and cleaning preparation known as Ronuk; this treatment will give to the articles a gloss instead of a shine. Liquid water stains may also be used for staining purposes.

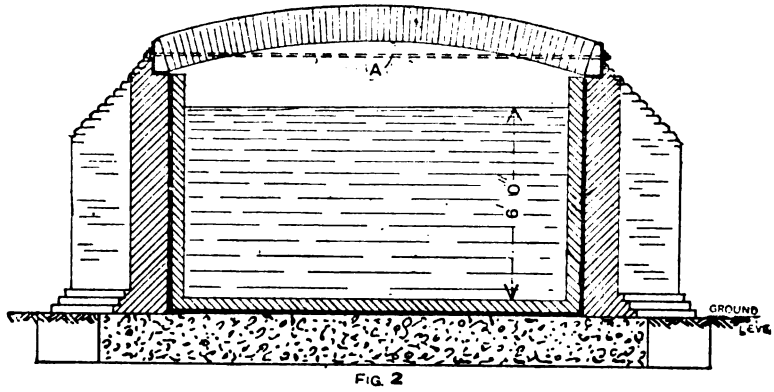


FIG. 2

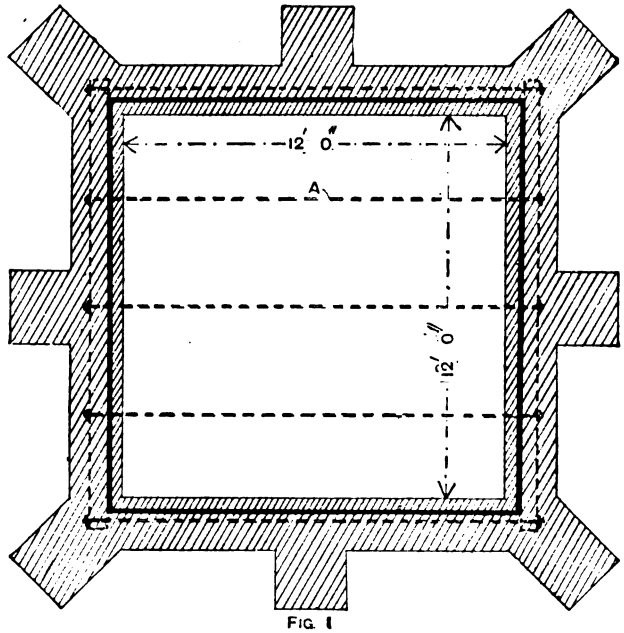


FIG. 1

Rainwater Tank above Ground.

Rainwater Tank above Ground.—Fig. 1 is a plan and Fig. 2 a section of a brick rainwater tank entirely above ground and arched over so as to be absolutely safe from pollution by anything deleterious draining into the tank. The tank is 12 ft. by 12 ft. by 6 ft. high. The main walls are 14 in. thick, with a 2-in. cavity filled with asphalt, and an inner brick wall 4½ in. thick, making a wall 20 in. thick altogether. Strong buttresses should be placed in the middle of each side and at the angles, as shown on the plan, the projection being 1 ft. 10 in.; or the buttresses may be omitted, in which case the walls should be 3 ft. thick. The roof is formed of an arch of single span 14 in. deep, the thrust being taken by two special cast-iron abutments, tied together with 1¼ in. wrought-iron tie-rods A. These tie-rods are necessary, as the walls unless tied together would not be able to carry the arch. Whether the walls would withstand the pressure caused by the freezing of the contents of the tank is a problem that can only be settled by experience, as the action of frost under such circumstances is not calculable. The walls with the vertical asphalt course will be absolutely water-tight, and a good suggestion is to heap earth against the outside of the tank. The earth will reduce the effect of frost in winter and also keep the contents of the tank cooler in summer. The foundation is formed of a 12-in. concrete bed (at 5 to 1), covered with a layer of asphalt and brick-on-edge paving. If the ground is bad or soft, this concrete foundation should be increased so as to take the weight without cracking, as any settlement of the foundation will break the walls of the tank and the contents will leak. The lining of the tank may be of salt-glazed bricks, pointed in Portland cement; the external walls should be built in Portland cement mortar. An access manhole and ventilator should be provided in the roof, and a draw-off pipe at the bottom of the tank; these are not shown in the figures.

Satin-wood Stain.—For a satin-wood stain take 1 pt. of methylated spirit, 1½ oz. of ground turmeric, and ½ oz. of gamboge. Steep to its full strength and strain through muslin. The stain may be applied with a piece of fine sponge or a camel-hair brush.

Pile Points.—Figs. 1 and 2 show cast-iron shoes for wooden piles such as would be used for piles intended to carry the weight of a structure. Fig. 3 is a cast-iron shoe for sheet piling, and is used for piles that are to be brought close together, so as to make as tight a joint as possible. Fig. 4 shows the screwed point of a solid iron pile used as a mooring pile. Fig. 5 is the screwed point of a cylindrical iron pile, as used for foundations of piers, viaducts, or buildings. Fig. 6 shows a pile used for similar foundations, but in work of a heavier class.

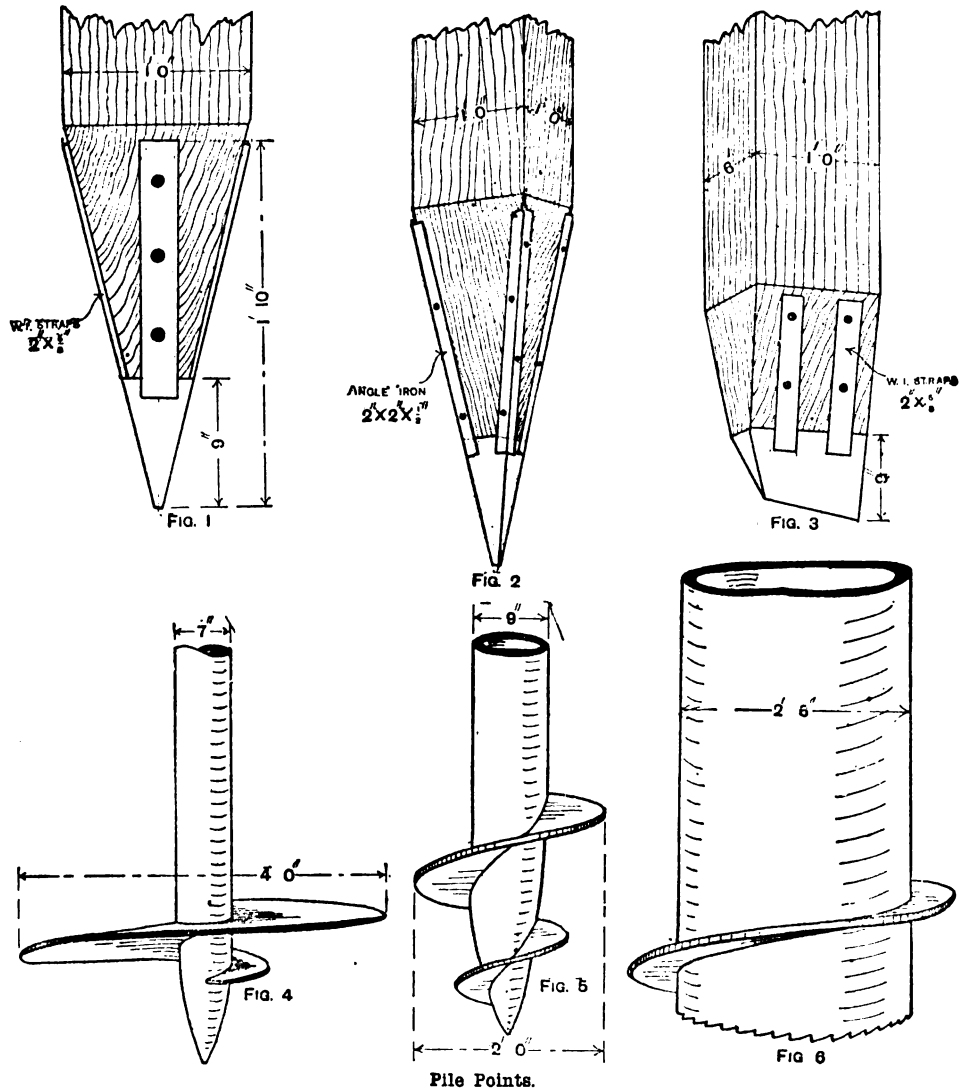


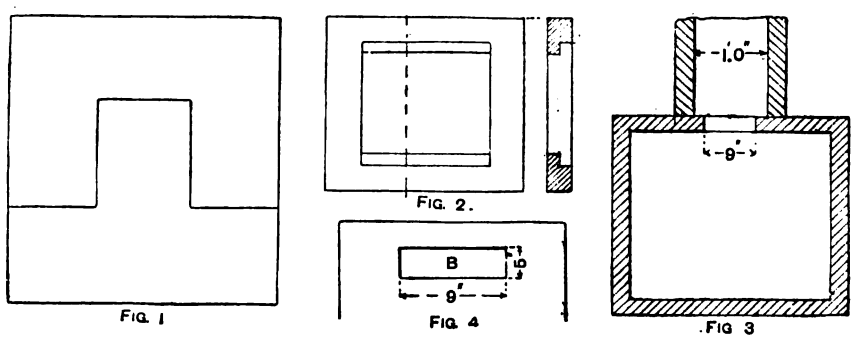
FIG. 1 FIG. 2 FIG. 3 FIG. 4 FIG. 5 FIG. 6

Pile Points.

Printing upon Solio Photographic Paper.—Solio requires the same treatment as other gelatino-chloride papers commonly called P.O.P. Fit the printing frame with a glass front, lay the film dull side up on the glass, and place the glazed side of the printing paper in contact with the film. Fill in the back pad and hinged flap, fasten the springs, and expose. Print slightly darker than the tone required in the finished picture. When printed, wash the print well until the water is no longer milky, and tone to the desired colour in ammonium sulphocyanide 20 gr., gold chloride 2 gr., water 20 oz. This quantity will tone one sheet of paper (about twelve half-plate pieces) to a cold purple black. For warmer tones the bath must be diluted. Toning should be complete in eight minutes. Fix the prints in hypo 3 oz., water 1 pint, and wash well in running water for an hour or more. The Eastman Co. recommend the making of a stock solution of gold sulphocyanide, which should afterwards be diluted with five times its bulk of water to be ready for use. But it is probable, however, that the beginner is less likely to be troubled if he prepares just before use, and with warm water, only the quantity required. The formula for the stock solution is ammonium sulphocyanide 150 gr., water 30 oz., gold trichloride 15 gr. These ingredients should be mixed in the order given and kept in the dark. Ammonium sulphocyanide is exceedingly deliquescent, but keeps well in solution if corked up, and should therefore be dissolved as soon as purchased. Gold chloride is sold in little glass tubes; these should be scratched with a file, broken open, and the contents of the tubes dissolved in a definite quantity of water, say ½ oz. of water to each grain of chloride of gold. Ammonium sulphocyanide should likewise be dissolved in a definite quantity of water, so that each dram of water contains a certain number of grains of the sulphocyanide. Distilled water should be used for making up the toning bath.

Substitutes for Sand.—According to A. C. Passmore, there are many available substitutes for sand, but they must all be crushed under rollers in a suitable mill until they are similar in size to grains of sand, and should be afterwards screened through a sieve of small mesh to remove the dust, and afterwards washed. Among the many substitutes may be noted ground pottery, coke breeze (except in damp situations), smithy ashes, and furnace slag, scoriæ, and similar substances of a hard gritty nature.

Furnace for Melting Brass.—A furnace made as follows will be found suitable for melting about 100 lb. of metal at a time. Make a hole in the floor 6 ft. 6 in. deep by 5 ft. wide by 6 ft. 9 in. from front to back. Cover the bottom of this with a brick floor, and well grout in with mortar. At a distance of 2 ft. 6 in. from the front of the hole, commence building the furnace proper. Build as Fig. 1, to a height of 2 ft. 9 in. Next get a framework of iron 18 in. square by 2½ in. thick, with a hole 12 in. square in the middle (see Fig. 2). A recess is cast in the front and back of the casting to carry the fire-bars, of which there are either three or four. After placing the iron-work for the furnace bottom in position, arch over the draughtway and continue the brickwork for a height of 2 ft. 6 in., using common brickwork for the outside, but best firebrick, well grouted in with fireclay, for the inside. This brings the brickwork up to the flue-hole. This (see Figs. 3 and 4) is formed by building a firebrick lined chamber, 12 in. square inside, and communicating with the chamber of the furnace by a passage B (Fig. 4) 9 in. long by 5 in. broad. Continue the brickwork another



Furnace for Melting Brass.

3 in. higher. On the top of the furnace place a plate of iron 1 in. thick by the size of the brickwork lining, or, say, 24 in. square with a hole 12 in. square in the middle. This casting is laid exactly over the centre of the furnace, the remainder of the furnace being covered with odd pieces of iron about 1 in. thick. The front of the hole is next lined with common brickwork, one brick thick, till the top is reached, when an open casting of diamond or rectangular pattern is laid over the hole, which provides a floor in front of the furnace and also a good draught-way for the furnace. The flue chamber must be connected with an existing chimney and all draughts stopped up, or a small chimney, say 25 ft. high, or higher if possible, by 12 in. square, inside measurement, must be built. The top of the furnace will require three furnace bricks, made of firebrick and iron hooped.

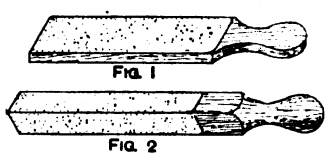
Preparing Sensitive Paper for Photographic Purposes.—The best kind of sensitive paper for an amateur to make is the "plain salted." This paper must be prepared immediately before use, and is therefore not a commercial article, whilst the tones and gradations the paper is capable of giving make it a great favourite with many artistic workers. This paper is good also for the production of platinum-toned prints. Choose a good sample of pure paper, such as Rives or Saxe, or failing this, or for broader effects, Whatman's smooth. Bank post papers and Arnold's pure unbleached paper are good. Glazed papers and the many notepapers containing kaolin or barytes cannot be used; success largely depends upon securing a suitable paper. Any undyed fabric (linen, satin, and silk or wool) may also be used. The preparation of the paper consists of (*a*) sizing, (*b*) salting, (*c*) sensitising. The object of sizing is two-fold: first, to fill the pores of the paper and keep the image on the surface (thus producing more vigorous prints); and secondly, to form an organic silver salt. If a piece of pure unsized paper (such as Swedish filter paper) were dipped in a solution of common salt and afterwards in a solution of silver nitrate, silver chloride would be formed by double decomposition; and if this paper now impregnated with insoluble silver chloride were exposed to light for a considerable time beneath a negative, those parts of the paper that were exposed most would darken to a deep violet tint, showing, however, no great difference between the shadows and the half tones, and on immersion in a solution of hypo-sulphite of soda the image would be greatly reduced, only a small proportion of the original image remaining. If now a similar paper is taken and treated in a similar way, except that the paper is first soaked in a solution of gelatine, starch, or arrowroot, the result will be that the sensitised paper will darken more rapidly, but to a red brown, and this image will lose only slightly in the fixing bath. In practice (*a*) and (*b*) are usually combined in one operation, as the salted paper will keep for a considerable time. The proportions in the various formulæ recommended for salting and sensitising vary very much, but the essential point is that an excess of silver nitrate shall be present in the paper. Substances combine in definite chemical proportions, and 340 parts by weight of silver nitrate combine with 117 parts by weight of sodium chloride. If two pieces of sensitive paper were to be prepared, one piece being first coated with silver nitrate and then with sodium chloride, and the other piece with sodium chloride first and then with silver nitrate, the latter method of preparation will render the paper the more sensitive. The theory is that the silver nitrate is an absorbent of chlorine, or in other words, that silver has a greater affinity for chlorine than for nitric acid. Lionel Clarke has advised the following formulæ, which have been found superior to all others. Arrowroot 180 gr., chloride of ammonium 120 gr. (the pure ammonium chloride must be used, not sal-ammoniac), re-crystallised sodium carbonate 240 gr., citric acid crystals 60 gr., water 20 oz.; all the chemicals used must be pure. Dissolve the citric acid, ammonium chloride, and soda carbonate in 4 oz. of water; do not stir the liquid at first or considerable effervescence will take place. Work the arrowroot into a stiff paste with a little water and add to the hot water slowly with much stirring. When cool add the dissolved crystals. (Ammonium chloride is decomposed by heat.) Test with litmus paper, and if acid, add ammonia until an alkaline reaction is obtained. The paper is then floated in this solution for ten minutes, great care being taken to avoid air bubbles. The paper may then be dried by heat, but must be kept flat. The paper is sensitised with a solution of crystallised citric acid 25 gr., distilled water ½ oz., and nitrate of silver 60 gr., distilled water ½ oz. Dissolve separately and mix the two and brush the solution over the paper with a Blanchard brush. When dry, the paper is ready for printing. The image may be toned with gold or platinum, or gives a pleasing colour if only fixed. Be careful to avoid over-toning and print very deeply. For the fixing bath, use hypo 2 oz. to water 1 pt.

Renovating Grandfather Clock Dials.—In renovating and lacquering the dial of a grandfather clock, first remove the hour circle and all ornaments. The silvered portions, such as circles, are blacked in and treated by the chloride-of-silver process described in Series I., p. 345. The dial plate and ornaments have the old lacquer removed by washing with spirit of wine and are well polished with pumice powder and water on a rag. The cast ornaments can be dipped for a moment in nitrous acid, and then thoroughly washed in clean water. These ornaments are best electro-gilt. The re-lacquering is done with ordinary gold lacquer while the metal is hot; some skill is required. The composition of a gold lacquer is as follows. Shellac, 8 oz.; gum sandarach, 2 oz.; arnotto, 2 oz.; dragon's blood, ½ oz.; turmeric, 8 oz.; and spirit, 1 gal.

Black Waterproof Boot Polish.—A black waterproof polish for boots and shoes may be made as follows. Procure 3 oz. of nutgalls, 2 oz. of borax, 1½ lb. of lac, 1 dr. of aniline black, and 3 oz. of ivory black or lampblack. Place the nutgalls in 1 gal. of water, and simmer over the fire until all the tannin is extracted. The liquid is then strained, replaced on the fire, and raised to boiling heat; the borax and lac are then placed in, and the mixture is simmered until the lac is thoroughly dissolved, after which the aniline black may be added, followed by the lampblack. The mixture is allowed to stay on the fire a few moments, constantly stirring, then taken off the fire and passed through a fine strainer, when it is ready for use. The mixture is applied to the leather by means of a sponge or brush; it dries with an enamel-like surface, which is quite waterproof. The composition should be thoroughly stirred or shaken before using.

Reviving Old Writing.—Some of the many methods of reviving old writing are the following. (1) Brush over with a weak solution of sulphocyanide in water, and expose to hot hydrochloric acid fumes. (2) Wash over with very dilute hydrochloric acid, and apply an infusion of galls. (3) Suitable for written matter that has been immersed in sea water: Wash well with water and soak in a solution of 3 grains of gallic acid in 1 oz. of water. If this is not effective, soak in a solution of 10 grains of protosulphate of iron in 1 oz. of water.

Blackleading Action of Piano.—Good quality blacklead, as sold in powder, should be mixed rather stiffly with methylated spirit and applied by a chip of wood to the hoppers, levers, jacks, or other parts to be burnished; or if several pianos are to be treated at once, the blacklead can be rubbed on by means of washleather or soft felt, and afterwards burnished. In shape the burnisher (see



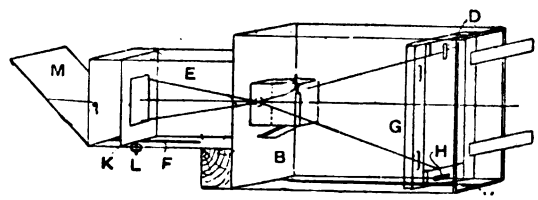
Burnishers for Piano Action.

Figs. 1 and 2) closely resembles a razor strop with its two or four sides covered with soft new chamois leather and secured by thin hot glue, which must be free from lumpiness. The burnishers improve by usage, but should be kept free from grit such as they would pick up by being carelessly flung on a workbench. A string through the handle whereby the burnishers can be hung up when not in use is advised.

Preparing Phototypes for Water-colouring.—With the exception of large quantities of wash, there should not be difficulty in applying water colours to phototypes printed from zinc blocks. The surface of the paper having been specially prepared for printing purposes, is not at all the same as that used for water-colour painting. The greasy nature of the ink may make the colours inclined to run in patches instead of lying flat on the paper, but in small work this may be prevented by rubbing the surface with chalk. If large washes are to be applied, the best way to get a flat tint is to well sponge the whole print with cold water and allow to remain for a few seconds. Dry off with blotting-paper and sponge over again. Dry again with blotting paper, and apply a wash of colour rapidly while the paper is still damp.

Black Japan for Steel and Iron.—The following is a description of the process of making a black japan suitable for dipping small steel and iron articles. Procure Swedish pitch 130 lb., asphaltum 5 lb., litharge 3 lb., black oxide of manganese ¼ lb., burnt Turkey umber 5 lb., terebine 1½ gal., boiled linseed oil 6 gal., and American turpentine 8 gal. Put the pitch in a copper or any suitable vessel, place it over a fire, and simmer slowly for about six hours; this liberates from the pitch all the greasy matter, which passes off as vapour: this, if not removed, would leave the japan with a dull finish. This operation is one of the chief factors in japan making, and is usually known as sweating the pitch. After the grease has been extracted, the asphaltum is added and thoroughly stirred, following with the burnt umber. In another suitable vessel place the boiled oil and heat to 480° F., then slowly add the litharge and manganese, stirring constantly to prevent the oil from rising and boiling over. The oil should be kept at this heat for about half an hour; this dissolves the litharge and manganese, giving the oil its drying properties. The prepared oil is now poured steadily into the pitch, briskly stirring during the operation. The whole mass is then heated to 480° F. for about one hour; this causes a thorough mixing of the ingredients. The pan is then taken well away from the fire, or, if the pan is a fixture, the fire should be slaked out with wet ashes and the japan allowed to cool down to about 160° F., when the turps is slowly run in by means of a tap placed in the side of the vessel, well stirring during the operation. After the preparation is cold, the terebine is stirred in and the japan placed in tanks to settle for fourteen days, when the clear portion is ready for use. If the japan is too thick, thin down with 3 parts of terebine to 1 part of turpentine. This japan dries with a hard gloss in about eight hours, and may be used for both inside and outside purposes; it is quite durable when exposed to the weather.

Box for Making Bromide Enlargements.—A simple plan of making bromide enlargements is to use a couple of boxes, as shown in the accompanying illustration. The back of the camera may be removed and the camera itself placed on a bracket in a box B, to cover an opening in the partition D. The lens, however, will be very slow for this work, and daylight would have to be used. The best enlargements are produced by daylight; but, of course, the method adopted is largely a matter of convenience to the operator. If a small lens working at *f*/6 or *f*/8 can be procured, artificial light supplied by a double-wick paraffin lamp, the light being collected by a condenser and projected through the negative, may be used. The illustration shows the apparatus arranged for daylight enlarging. The negative is enclosed in a



Box for Making Bromide Enlargements.

frame K, which may be moved up and down the box B and clamped at any distance by means of a thumbscrew L passing through a slot F. A V groove is cut in the floor of B, taking a block attached to the frame G. This frame (an ordinary printing frame with turn-back springs answers well) exactly fits the box B, and is covered on the outer edges with velvet. The frame is drawn backwards and forwards along the V groove by the handle H, and should work somewhat stiffly. To focus the picture, the negative is placed at K at approximately the correct distance from the lens. The frame G is filled with a sheet of ground glass, the rough side of the glass being towards the observer, and the focus adjusted. The ground glass is then removed, and a piece of clear glass, covered with a sheet of bromide paper sensitive side outwards, is substituted, the back of the frame filled in, the back of B covered with an opaque cloth, and the exposure made. The distances will depend upon the focus of the lens and the ratio of the image. A turnbutton D should be fitted to the top rail of the frame G to hold the glass whilst focussing. M is a reflector, set at an angle of 45°, to illuminate the negative evenly.

Polish for Glacé Boots.—To make a polish for glacé boots, procure 1 gal. of vinegar, ½ gal. of water, 1 lb. of white glue, 2 lb. of logwood chips, 1 oz. of soft soap, 1 oz. of isinglass, and 1 oz. of powdered indigo. Mix the vinegar and water, then add the glue and heat to boiling; when dissolved, add the logwood chips and boil for half an hour, then add the soap, isinglass, and indigo, and boil for ten minutes. Strain through muslin, and, when cold, bottle up. Apply with a sponge.

Preparing Canvas for Painting.—Canvas may be primed for oil painting by first covering it with a thin coat of size, and then with red or white lead and boiled linseed oil to which a small quantity of chalk has been added. A good priming is made by giving the surface a thin coat of gold size, and, when this is dry, applying one or two coats of equal quantities of pipeclay and chalk mixed with size. Considerable care is required in applying the priming so as to secure an even surface. The ground should be thin, yet sufficiently thick to cover the threads of the canvas, and free from any knots or blemishes.

Axle Grease.—Yellow grease as used for railway wagons is made with palm soap, tallow, mineral oil, and water. It is not suitable for road vehicles, as it allows the axles to rust. Tallow melted with sufficient machine oil to bring it to the consistency of soft butter when cold makes a more efficient lubricant for cart axles.

Blackening Opera Glasses.—A black stoving enamel is generally employed for opera glasses, etc. These enamels, which are made specially for the purpose, are, as a rule, composed of linseed oil, copal or other resin, asphaltum, and turpentine. They dry quickly, and will withstand a moderately high temperature without any deterioration. The articles to be blacked are first made smooth and perfectly clean, a coat of the enamel is applied, and, after it is dry, the articles are hung for several hours in a stove kept at a temperature of about 300° F. This treatment is repeated perhaps two or three times until a perfectly smooth, level, and brilliant black coating is obtained.

Wood for Making Harps.—White pine from the forests of Bohemia and Switzerland is generally considered best for making harps, owing to its freedom from knots, wide width, and high sensitiveness to musical vibrations. It is used chiefly for piano sound boards and the manufacture of string instruments as violins.

Polishing Belts for Finishing Wheel Spokes.—Endless polishing belts, such as are used for cleaning up spokes turned in a copying lathe, have usually a leather foundation with a felt covering, or a solid thickness of indiarubber in which canvas is interwoven. The sandpaper or glasspaper is fixed on in various manners in disc machines by rubber bands, and in some of the machines the glue and finely sifted glass or sand, as the case may be, are applied direct to the belt.

Appliance for Straightening Wire.—The accompanying illustration shows the top of a simple device for straightening wire. It is made of a block of wood

Straightening Wire.

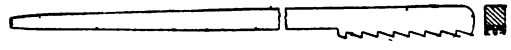
3 in. or ¼ in. deep, 4 in. wide, and about 15 in. long, in the top of which is inserted a number of iron pegs or nails placed as shown. To straighten the wire, it should be pulled right through the middle of the two rows of pegs. It is advisable to have different blocks and pegs for the different gauges of wires.

Photographs Made in Metal Dust.—The colouring material to be employed as a paint on photographs in order to produce the appearance of brass or copper depends partly on the subject of the photograph. The gold and bronze powders obtainable of any oil and colourman may be mixed with gum, and, preceded by a wash of a dark colour, applied to the print in the usual manner, but the result is not always satisfactory. Possibly, a better plan would be to make a new print by the "dusting-on" process. Procure a camel-hair mop about 1 in. in diameter, a sheet of finely ground opal of the desired size, and the necessary metallic powders. Make up the following mixture. Gum arabic (best) 80 gr., white sugar 60 gr., alcohol 1 oz., water 7 oz., mercuric chloride 2 gr. Dissolve the gum arabic in one portion of the water and the sugar and mercuric chloride in the other portion, mix the two together, and add the alcohol; this solution will keep indefinitely. When required for use, take a sufficient quantity and add 10 gr. per oz. of bichromate of ammonia Carefully clean the opal with whiting, then flow over with the above solution, which should have been filtered. The plate is now drained, and dried in the oven at a temperature that just allows the plate to be touched by the hand. As the plate dries it becomes very sensitive to light, many times more sensitive than albumen paper. If the picture to be copied is mounted, a negative must be made and a transparency from the negative, for the process gives a negative from a negative and a positive from a positive. If the picture is unmounted, it may be waxed to get rid of grain and heated to allow the wax to penetrate well into the fibres of the paper. Then iron the print between blotting paper, and, whilst still hot, place both the print and the opal in a printing frame and expose in the usual manner in photographic printing. About two minutes in bright sunshine is the average time for a transparency, but probably twelve minutes will be required with a print. A visible image prints, but must not be examined during printing. When the picture is printed, remove it from the frame and drop a little heap of the powder in the centre and spread rapidly to the edges with the mop. Keep the powder moving until the image is well out. It may be necessary to breathe lightly on the plate, but this breathing should be avoided if possible, as it is liable to cause muddy high lights. Brush off the superfluous powder and coat with collodion. Soak in water until wetted evenly, and then in a saturated solution of common alum until the yellow colour of the bichromate has disappeared. An image in the metal results.

Painting Street Door.—A street door that is to be painted should first be given two coats of priming paint made of genuine white lead mixed in equal parts of raw and boiled linseed oil with a little turps and driers. The second coat may be tinted with any desired colour so as to form a groundwork for the colours. The work, when thoroughly dry, should be rubbed down quite flat with No. 1 sandpaper. Two coats of colour prepared as follows should then be given. The colours should be ground into a paste with turpentine, then thinned down with more turps, sufficient boiled oil being added to bind the colour, *i.e.* to prevent rubbing up when dry. Each coat should be flatted down with No. 0 sandpaper and well dusted to remove all grit. The doors should then be given two coats of good copal varnish of thoroughly good quality.

Fastening Grating in Bottom of Enamelled Bowl.—Instructions on fastening to the bottom of an enamelled bowl a grating for waste water are given below. If a brass waste connection, with fly nut and union, is attached to the bowl, it can be taken out and a brass bridge piece soldered or riveted inside near the bottom of the connection. A brass bolt can then be passed through the bridge piece and a hole in the centre of the grating, and screwed up tightly before fixing in the bowl. The grating could be soldered to the connection, but the screwed bolt is preferable, as with this the grating can be taken out when desired.

Tool for Chequering Gunstocks.—The chequering on the butt of the gunstock is done with a chequering tool about 3¾ in. long, which is used in a wooden handle



Tool for Chequering Gunstocks.

such as a small file handle. The accompanying sketch, which is full size, shows a side elevation and section of the tool. It has three rows of teeth, grooved as shown, but a tool with two rows is best for a beginner. The tool must be kept sharpened, and it will be necessary to practise on a piece of walnut wood previous to working on a gunstock.

Applying Gold Leaf.—In applying gold leaf, first stencil or paint in the design with gold size, and allow to remain till tacky or nearly dry. The gold leaf is then spread on the design in a similar way to cheap transfers, and brushed or pressed on with a rabbit's paw or a special dabber brush, usually sold at 6d. each. When the gold size is thoroughly dry, which usually is in about twelve hours, the surplus leaf may be dusted away. A coat of pale copal varnish should then be applied.

Igneous and Aqueous Rocks.—Igneous rocks, of which the granites and syenites are the most common examples, are rocks that have been formed of materials melted by the internal heat of the earth and afterwards pushed up through fissures in the earth's surface. The aqueous or stratified rocks, of which Portland, Bath, and Mansfield stones are examples, are rocks that have been formed of materials once held in solution and deposited by water, and are stratified or arranged in beds. The stratified rocks are, of the two, the more useful in building, as these rocks are easily wrought to the required shapes, and are strong enough for most constructional purposes. The unstratified rocks are used where powerful resistance to superincumbent weight, or, as it is termed, greater crushing strength, is required, and ability to withstand the effects of weather.

Black Mortar.—A small quantity of lampblack mixed with red sand mortar will make it black. In order to ascertain the amount of lampblack required, a known quantity (say 4 oz.) should be mixed with a hod of mortar, and more mortar added until the mass begins to show a light tinge. Having ascertained the quantity of mortar for which 4 oz. of lampblack will suffice, the necessary calculations for the entire job are easily made. For common work ordinary soot will be more economical.

Copper-coloured Paint.—For copper-coloured paint for outdoor work, mix white lead 18 parts, middle chrome 4 parts, venetian red 3 parts, and raw umber 1 part, with boiled oil, turps, and a little gold size. If the paint is not red enough, add a little more venetian red; if not quite dark enough, add more brown. By using the above colours in variable proportions, any shade of copper colour may be obtained.

Gauged Rubber Gothic Arch.—In Fig. 1 of the illustrations of a gauged rubber Gothic arch AB is the span at the springing line, the centre of the opening being at C, from which set up the rise as at CD. Bisect DB with line EF, cutting springing line at G. G is the centre for the arcs on the right side of the figure; the centres for the arcs on the left being obtained by symmetry, as at H. Set off along CA continued the two arch rings as at J and K, the radius of soffit being HA, whilst the other curves are parallel. In filling in the arch, prick over the extrados a distance that the bricks will work (say, 3 in.), and draw joints radiating to the centres from which the arcs are described. For the inner ring, set off on each side of the centre line a distance of half the thickness of the voussoir, that is 1½ in. as at LL, and working from this point mark over as before. It has been objected that the key brick in the first ring, Fig. 1, is a wedge-shaped piece, which, although very often put in, is not correct. In the first place the true Gothic should always have a straight joint at key, which has a much better appearance; also the two joints which would meet at the bottom of this piece would leave a ragged appearance on the soffit. According to one opinion, Fig. 2 shows the more usual method of cutting this arch.

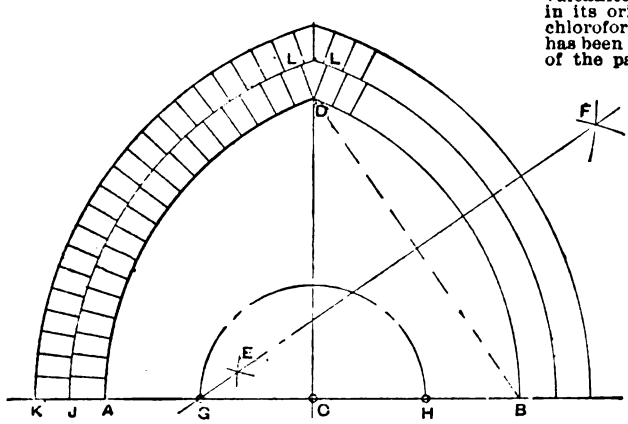


FIG. 1

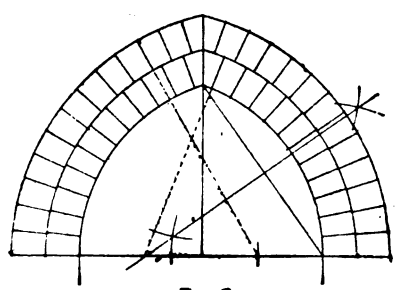


FIG. 2

Gauged Rubber Gothic Arch.

Pipe Organ Cyphering.—When a pipe organ cyphers, either the action is stiff so that the pallet spring cannot close the pallet, or a chip or particle of some substance has found its way into the valve, or else the key adjustment is faulty. Sometimes cyphering occurs if the keys warp or twist. If by relieving the pressure of the key and testing the backfalls for freedom, etc., cyphering is not cured, the wind chest must be opened and any chips, etc., cleared away from the face of the pallet with a thin wire.

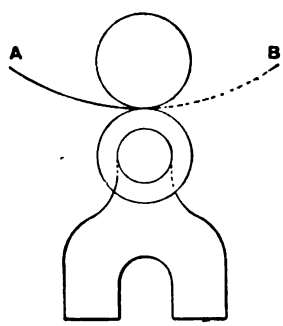
Repairing Artificial Teeth Palate.—A temporary repair may be made in the palate of a set of artificial teeth by first drilling very small holes along each side of the fracture and then lacing up with fine floss silk. If the palate is made of metal, join the broken parts by waxing the hollow surface whilst held in position. Mix a teacupful of superfine plaster-of-Paris, pour it carefully in the opposite side, build it 1 in. high, and trim carefully round the teeth. When this has set, take the teeth off the model and wash the artificial plate clear of plaster, sandpaper the fractured edges of the metal, replace again on the model, and cover the fracture carefully with hard setting wax. Mix half the previous quantity of plaster, add two tablespoonsful of very fine sand, rinse the teeth under cold water, and cover the case on both sides, only leaving the wax uncovered by the plaster; trim neatly when set, and run the wax off by pouring boiling hot water upon it. When dry, place the bottom side on an open Bunsen burner until thoroughly heated, in fact, until nearly red hot. Whilst the case is being heated, get ready for soldering by rubbing a piece of borax in a little water on the rough surface of a plate of ground glass. Also cut small squares of solder and place them in the rubbed borax, taking care they are well covered by the solution. In the soldering tray place the case with the part to be soldered at the top, and, using a blowpipe, join a small piece at a time, guiding the solder to run rightly with a sharp steel point dipped in the solution. Take care that the case is kept at a uniform temperature. If there should be any holes or spaces about the fracture into which the solder will not run, get a piece of thin wire of the same material as the case, bend it to fit, and flatten with a riveting hammer; dip it into the solution, put it into place, and according to the size of the strip, place one, two, or three small pieces of solder equidistant on the strip. Then a small steady flame worked gradually from end to end of the strip will soon fill up and hide the joint. Put the case on a piece of dry wood to cool, and in about ten minutes place it in a basin of warm water, when the plaster will fall off; wash it, place it in dilute sulphuric acid to dissolve the borax, smooth it with a scraper and superfine glasspaper, and polish with fine pumice powder, whiting, and rouge, these being applied separately in the order given. If the vulcanite roof is perished it will be better to have the teeth reset on a new base. If a tooth is pushed off, clean it perfectly, make a dovetail slot where it has come out, and pack into its place soft vulcanite dissolved in chloroform; fix the tooth back in its original position, allow about an hour for the chloroform to evaporate, and if too much chloroform has been used, add a piece of ordinary vulcanite on top of the packed rubber and cover again with a small quantity of the dissolved rubber. Let the case stand another hour, then prick it all over with a sharp point or needle and press it all over with a wet finger or thumb to squeeze out any spirit blobs. Then in a metal flask, cover it with fairly stiff plaster-of-Paris, clamp up the flask, and bake in a vulcaniser for an hour and a quarter at 315°F. After cooling, take the case out of the flask and cut the plaster away very carefully with a knife, wash it and scrape away the rough edges of the repair, smooth up with sandpaper, and finish first with a cork and pumice powder, and lastly with a soft brush and whiting.

Varnishing Racing Barge.—In varnishing a teak-wood racing boat or barge, the stem, sternpost, and gunwales of which are of oak, the stem and sternpost are allowed to retain their natural colour, but the gunwale should be stained to match the teak. Size is not suitable for this kind of work; the barge should be first coated with painter's ordinary knotting and afterwards varnished. A little amber brown mixed with the knotting before it is applied to the gunwale will bring it to the colour of the teak.

Tailors' Crayons.—Tailors' crayons are made from French chalk; it may be mixed with a little china clay to render it harder and more coherent. Sufficient water is mixed with the chalk to make it hold together but not to render it pasty, after which it is kneaded in a mixing machine. The mass is then pressed in iron or brass moulds. The following machinery is required. A kneading machine, several iron or brass moulds, a hand or steam press for compressing the material in the mould, trays for drying, and a drying chamber or warm room. French chalk must not be confounded with ordinary chalk; the latter is carbonate of lime, and is the same as whiting; French chalk is a silicate of magnesia, and is a finely divided variety of the mineral steatite, also known as talc, soapstone, etc. It is termed soapstone owing to its slippery feel. For the preparation of ordinary chalk see Series I., p. 331.

Polishing Edges of Glass Shelves.—The edges of glass shelves generally are polished on a rotary table of York stone, sand and water being used freely. To do the work himself by hand labour, the amateur must procure a slab of blue York stone and grind the edge of the glass by working it backwards and forwards, using fine grit and water. The work is then polished with snakestone and finished with felt and putty powder.

Globe Enameller for Photographic Prints.—Below are a few hints on the use of the Globe enameller or burnisher for photographic prints. The prints to be burnished by this method should be dry, but not bone dry; the exact condition that gives the best results is rather difficult to represent in words, but the prints, if dried spontaneously in a room of normal temperature, should be fit to burnish in an hour. If the prints are too dry, they will yield a poor surface tending towards cracking, and if too damp, will blister and stick to the roller. The rollers should be wiped occasionally during heating, in case any sweating occurs, which would cause the rollers to rust or the prints to blister. Rub the rollers well with a perfectly clean dry cloth (revolving the handle meanwhile), then moisten the finger and touch the lower roller. If a hissing noise results, the roller is too hot; if the roller simply dries at once, the temperature is correct. Having adjusted the machine by the lever at the left side, test with a trial print that is of no value. Dust the print carefully, and, holding it face down, place one



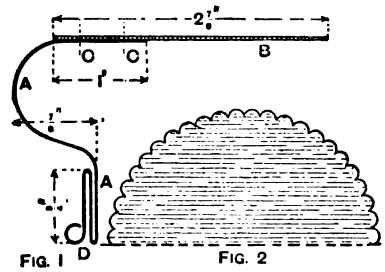
Globe Enameller for Photographic Prints.

end between the rollers, which should be adjusted loosely, and wind through. Now tighten down the rollers until a fair grip, but not sufficient to disturb the face of the print, is obtained. The mounted prints may now be passed through, once from each end and twice lengthways, and the result should be a high glaze without any of the defects complained of. In passing the pictures through lengthways, the mounts should, until halfway through, be bent slightly upwards as shown at A (see illustration), when the part B should be lifted by the fingers as shown, thus imparting a slight convex curve to the surface of the print. This curve will afterwards disappear and the prints will lie quite flat, but if the convex curve is omitted, the prints will afterwards curl inwards.

Analysis of Indiarubber.—The qualitative and quantitative analysis of commercial indiarubber is a complicated operation, because it is very rare to find it pure, and it may be necessary to determine the amounts of the unvulcanised and vulcanised rubber, rubber substitutes, free sulphur, and mineral matter, which latter may require to be separated into its various constituents. The following is an outline of the process: The mineral matter or ash is determined by igniting about 1 gramme of the sample, the residue can be examined qualitatively for acids, bases, etc. 5 to 10 grammes of the sample are extracted in a Soxhlett tube with boiling acetone. After evaporating off the acetone the free sulphur is left behind; the residue is boiled with an alcoholic solution of caustic soda, which removes the rubber substitutes (vulcanised oils). After drying, the residue is treated with boiling nitrobenzol, which removes both the vulcanised and unvulcanised rubber. The residue consists of mineral matter, plus a small amount due to absorption of soda from the alcoholic solution. A correction is required for this both in estimation of mineral matter by this method and in determining the amount soluble in alcoholic soda. The total sulphur is estimated by heating a portion of the rubber in a sealed tube under pressure with concentrated nitric acid; the solution is precipitated with barium chloride, the barium sulphate weighed and calculated to sulphur. The specific gravity test is of little use for examining commercial indiarubber; it applies only to pure or moderately pure rubber; the lighter the rubber the less mineral matter it contains. Two tests of endurance are also applied: one is known as the "dry heat," the other the "moist heat" test.

Steel-colouring Brass Wire.—The nearest tint to new steel obtainable on brass wire is the one that is produced by the potassium sulphide process. The lengths of brass wire must be made perfectly clean and bright, then given a thin coat of silver in an ordinary silver-plating solution, after which the wire should be dipped in a hot solution of potassium sulphide (liver of sulphur) until quite black, or brushed with the hot liquid, then rinsed in clean water, dried, and finally brushed with a soft brush to get the required lustre. The dark coat on this wire will not bear bending or rough treatment, as it will readily scale, and should be lacquered if the dark coat is to be protected. A darker colour can be got by dipping the clean brass in a solution of platinum chloride, then washing, drying, and brushing as before. The coat is not more permanent than the other. A more permanent coat may be obtained by running the wire through a bath of molten lead, and thus giving it a thin coat of lead.

Smoke Diffuser.—The appliance shown in side elevation by Fig. 1 is intended to be fitted to the top of a lamp glass to prevent the ceiling from getting smoked. It consists of a piece of steel A, about $\frac{3}{16}$ in. wide and $5\frac{1}{4}$ in. long, bent to shape. A circular piece of mica B,

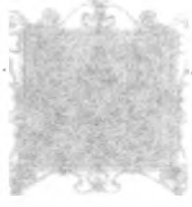


Smoke Diffuser for Lamp.

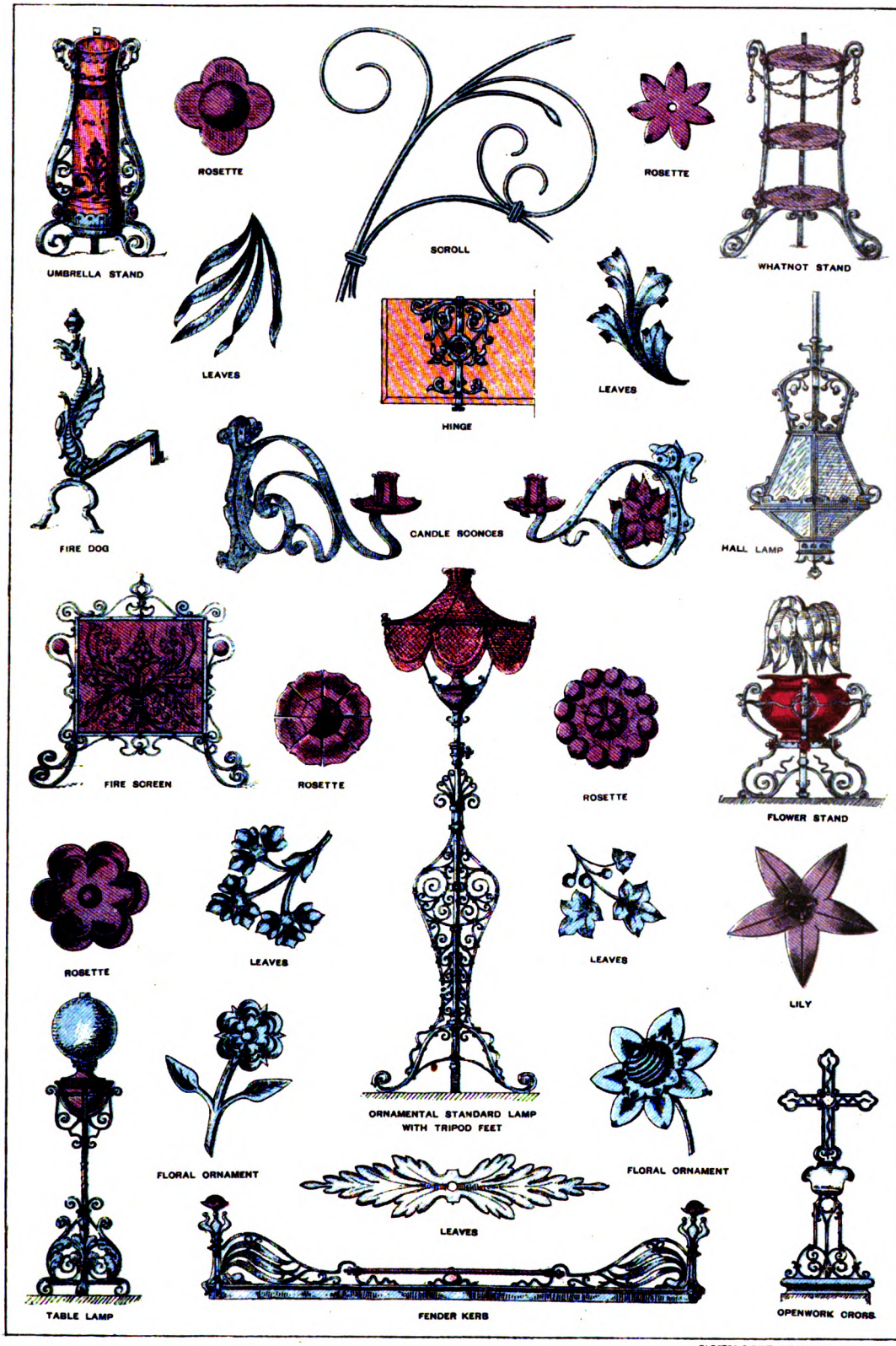
which can be ornamented as shown in the half plan, Fig. 2, is fixed at C (Fig. 1) to the steel piece by small rivets. The appliance is fixed by the chimney fitting into the groove at D.

Cod-liver Oil Capsules for Poultry.—The simplest way to administer cod-liver oil to poultry is to incorporate enough for (say) twenty doses with ten times its weight of flour, and then add sufficient water to form a stiff dough; then divide the dough into twenty pieces, and roll into pills with a little dry flour. The pills can be moistened before being given, to render them easier to swallow. Capsules may be made as follows:—The two moulds are made of hard wood, in which a number of holes are bored; these holes vary in size according to the dose to be taken; about $\frac{1}{2}$ in. in diameter and $\frac{3}{4}$ in. deep would be suitable for one mould, whilst the holes in the other should be a trifle (say $\frac{1}{16}$ in.) smaller. The gelatine for the capsules is made by dissolving 8 oz. of gelatine in 11 oz. of water, then adding 6 oz. of glycerine and 4 oz. of sugar syrup. While this mixture is hot, it is poured into shallow trays to a depth of about $\frac{1}{4}$ in., and when cold it is cut up as required. The moulds are oiled to prevent the gelatine adhering, and each one is provided with a plunger with a rounded end; the bottoms of the holes in the moulds should also be rounded. The plungers, which are also oiled, are about $\frac{1}{8}$ in. smaller in diameter than the holes in the moulds. Having cut the gelatine into squares, place these over the holes in the mould and force it in with the plunger; when all the holes are filled, remove the excess gelatine with a knife, and set the mould in a warm place until the capsules have dried a little and shrunk, when they can be turned out. The capsules from one mould will fit in those from the other, and the cod liver oil can be placed in before they are closed. After closing they will adhere and form practically a sealed tube.

White Paint for Cloth, Calico, etc.—For a white paint that will not run on cloth, calico, etc., stir well together zinc white (in paste) 3 lb., French oil varnish $\frac{1}{2}$ pt., and pale gold size $\frac{1}{2}$ pt., and thin down with American turpentine. This paint dries in about six hours, with a good body.



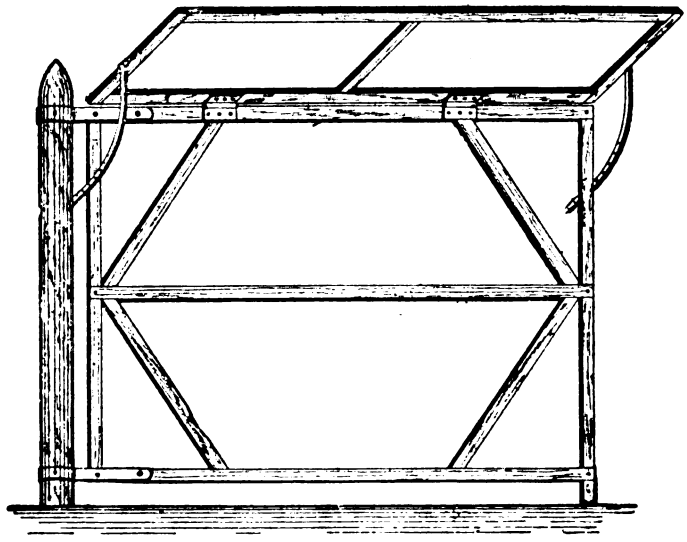
WROUGHT IRONWORK.



CASSELL & COMPANY, LIMITED, LITH. LONDON.

Coating Lead Cistern to Prevent Corrosion.—To act as a protective coating that will keep the bottom of a lead cistern from being eaten into holes a mixture of resin and tallow is good, but the quantity of resin should be in excess, for with too great a proportion of tallow decomposition sets in and pollutes the water. Pitch applied hot is also good, but gas tar should not be mixed with the pitch. In practice, a good coating of limewash, made from caustic lime, applied when warm and allowed to dry before filling the cistern with water, has been found to be very good. The coating should be renewed yearly, or as often as the cistern is cleaned out.

Garden Sun Screen.—To make a sun screen for the garden, first construct a light but rigid frame 7 ft. long and 5 ft. 6 in. high, with the bottom bar fixed a few inches from the ends of the uprights. Two-in. square stuff may be used, and the frame may be strengthened by a centre bar and corner pieces. To one upright fix a foot, to steady the frame on the ground. Stain or paint the frame, and then neatly tack on striped canvas; this forms the back of the screen. For the top, make a light frame 7 ft. by 2 ft. 6 in., stain it and cover with canvas. Fix this top to the upper bar of the back with two hinges; also fix a window-sash bracket to each end of the top and



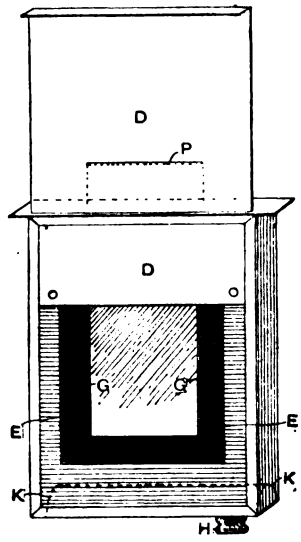
Garden Sun Screen.

to the uprights of the back. Thus the top can be secured at any angle from almost vertical to laying flat against the back. Round the top tack an ornamented fringe of canvas 6 in. deep at the front and ends, and at the back let it be 12 in. deep, so as to fall over well. To fit up the screen in the garden, sink a post to stand 6 ft. above the ground. Bend two pieces of strong hoop iron to fit round the post, and screw the ends on each side of the upper and bottom bars of the back, embracing the upright which has no foot. Lift the screen up and slip the hoops over the post. The post and hoops keep the screen secure from falling, and the foot on the other upright makes all firm. If the lower hoop is fixed with a swivel it will be much easier to lift on and off. As the screen will revolve round the post there is no trouble in placing it according to the position of the sun. The sizes mentioned suit a comfortable shade for at least three chairs. The ornamentation of the screen is a matter of taste.

Electro-tinning.—Here are instructions on making and working an electro-tinning solution suitable for small brass and iron articles. Dissolve 1 lb. of common washing soda, ½ lb. of best pearlash, 1½ oz. of caustic potash, and 1 dr. of potassium cyanide in 1½ gal. of warm rain water; then add ¼ lb. of tin peroxide and 1 dr. of zinc acetate, well stir until all is dissolved, and filter through a piece of calico. This solution should be kept in a stoneware vessel immersed in hot water in an outer vessel of metal, as it will have to be kept at a temperature of 75° F. whilst working. An anode of pure tin must be employed to feed the solution with tin, and it may be worked by current from two Bunsen cells, or the current from a small dynamo giving a pressure of not more than 4 volts. Add small quantities of caustic potash and potassium cyanide as may be required to keep the anode and solution in working order.

Smoke-producing Mixture.—A mixture that will produce a dense smoke when ignited has the following proportions. Seven parts of chlorate of potash, 1 part of charcoal, and 2 parts of ammonium chloride, all in powder and thoroughly mixed.

Photographing and Developing Camera.—A camera that is claimed to take and finish a photograph in a few minutes is constructed to take ferrotype dry plates somewhat on the principle of an automatic ferrotype camera. The camera is of the hand camera form, and is simply a box with a lens in front of the frame, and a shutter worked by pressing down a rod. A spring keeps the shutter closed. The chief feature of the camera is the plate holder (see sketch), which serves the combined purposes of plate holder, dark room, and developing dish, as will be presently explained. P is a flat tunnel through which the plate may be dropped into the grooves G. D is the draw-shutter, which permits the exposure of the plate in the camera through the frame E. H is a brass cap closing the hole through which the developer is poured, and K (dotted



Photographing and Developing Camera.

lines) is a strip of metal bent over to form a tunnel light-trap when H is removed. The plates are contained in bags closed with a rubber band. On slipping the end of one of these over P, and holding tight with the band, the plate may be allowed to pass, without fear of fog, into the plate holder ready for exposure. The camera must be supported on a table, tree trunk, or anything firm, as the exposures are seldom very short. Having pointed the camera in the right direction (a view finder ought to be attached), the shutter D is drawn and the button pressed for from 1 sec. to 20 sec., according to the subject and the conditions of light, etc. Close the shutter, unscrew H, and flood the plate with the developer for from 10 sec. to 60 sec.; the higher the temperature the quicker will be the development. The developer is then returned to the bottle for future use, and the fixing solution poured in at H. In about 30 sec. the plate may be removed from the camera and dried by heat if necessary. The camera measures 6 in. by 4¼ in. by 3¼ in., and weighs about 14 oz. It is simple and ingenious, and probably gives satisfaction where there is no convenience for developing.

Cleaning Confectioner's Windows. — Perhaps the best material to use for cleaning a confectioner's windows thickly coated with sugar is hydrochloric acid; the ordinary hydrochloric acid (spirit of salts) may be diluted with eight or nine times its volume of water and rubbed over the windows with a rag, and the whole then washed off with water. The acid must not be put in a metal bucket, but should be kept in an earthenware pot, and care should be taken that it does not get into cuts on the hands.

Britannia Metal.—Britannia metal is a greyish white alloy of tin, antimony, and copper in varying proportions; the tin is the essential metal, the others being added to give the desired hardness; sometimes, also, bismuth, zinc, and lead enter into the composition. A good quality Britannia metal is made by adding an alloy of equal parts of plate brass, tin, bismuth, and antimony to molten tin, until the desired colour and hardness are obtained. The "hardening" used in the formation of some Britannia metals is an alloy of 2 parts of copper and 1 part of tin, and it is this alloy which is alluded to in the following table of the various compositions known as Britannia metal:—

Tin.	*Antimony.*	*Brass.*	*Copper.*	*Hardening.*	*Zinc.*
81	16	—	1	—	2
50	1	40	—	—	—
94	4	—	2	—	—
86·8	8·8	—	—	4·4	—
92	6·2	—	1·8	—	—
140	5	—	2	—	—
300	15	—	4	—	—
100	5	—	—	5	—
150	10	—	3	—	—
140	9	—	3	—	—
210	12	—	4	—	—
100	4	—	—	4	—
100	8	—	—	8	—

Enamels.—According to Salter's translation of Paul Randau's standard German work on the preparation and application of enamels, it is necessary for the intending manufacturer of enamels to understand the nature of glass, since enamels consist of glass rendered either transparent or perfectly opaque. Three kinds of raw materials are used in making enamel: (1) those required for the production of the glass, (2) those used to convert the glass into an enamel of a given colour, and (3) those serving to increase the fusibility of the product. A point worth remembering is the action of light on glass. Glass on exposure to light either changes in shade if previously coloured, or, if colourless, acquires a tinge of colour. For example, glass that has been decolorised by manganese compounds turns a beautiful violet shade after prolonged exposure to light; enamels are affected in this way also. Randau gives the following statement showing the colour changes undergone by different kinds of glass:—

Glass.	Before Exposure to light.	After Exposure to light.
French sheet	Bluish white	Yellowish
German crystal	Faint green	Bluish tinge
English sheet	Faint green	Yellowish green
English crown	Faint green	Faint purple
Belgian window	Brownish yellow	Dark purple
English window	Dark green	Brownish green
American crystal	White, faint bluish tinge	White purple
American crystal	White, faint bluish tinge	Faint yellowish green
Ordinary American	Bluish green	Unchanged

The following is a list of the pigments employed in enamel manufacture. For yellow: Antimony oxide, potassium antimonate, lead antimonate, silver oxide, ferric oxide, uranium oxide. For red: Ferric aluminate, sodium-gold chloride, tin-gold chloride, purple of Cassius. For orange: Mixtures of pigments for yellow and red. For green: Cupric oxide, chromic oxide, ferrous oxide. For blue: Cobaltous oxide, cobalt silicate, or smalt zaffre. For violet: Manganese oxide. For brown: Ferric oxide. For black: Ferrous oxide in large proportion. If enamels are not elastic they crack and flake off when the metal to which they are applied expands or contracts. Sufficiently elastic enamels were not obtained until the practice was adopted of replacing a single layer of enamel by two coats of different molecular and chemical properties, the one mass being termed the ground, and the other the covering layer. The following are ground enamels (for direct application to metallic surfaces to form a foundation for the cover enamel). For a very refractory mass, No. 1: Fuse together quenched and ground flint 30 parts, and borax 20 parts. To the fused mass is added, during grinding, about 25 to 40 per cent. of flint meal and an equal quantity of white clay, the fusibility varying in indirect proportion to the amount of these two substances. Ground felspar may be employed to replace the added flint meal. For a very refractory mass, No. 2: Fuse together flint meal, 30 parts; borax, 16·5 parts; and white lead, 3·5 parts. Then grind with flint meal, 25 to 40 parts; clay, 20 to 25 parts; and magnesia, 5 to 6 parts. Owing to the presence of magnesia, No. 2 mass is more refractory than No. 1, but is more easily applied and adheres better to the superimposed cover enamel. For a refractory mass, No. 3: Fuse together flint meal 50 parts, and borax 30 parts. Then grind with silica 13 parts, and clay 13 parts. For a refractory mass, No. 4: Fuse together flint meal 50 parts, and borax 30 parts. Then grind with silica, 15 parts; clay, 13 parts; and magnesia, 1 part. For a fusible mass, No. 5: Fuse together flint meal, 30 parts; borax, 25 parts; and felspar, 30 parts. Then grind with clay, 10·75 parts; felspar, 6 parts; and magnesia, 1·25 parts. For a ground mass for iron utensils, No. 6: Fuse together flint meal, 30 parts; borax, 16·5 parts; and white lead, 3 parts. Then grind with flint meal, 9 parts; clay, 8·6 parts; and magnesia 0·5 parts. For a ground for backing delicate coloured enamels, No. 7, the proportions are sand, 3 parts; chalk, 1 part; and calcined borax, 3 parts. For a refractory ground for the same purpose, No. 8, the proportions are quartz meal, 60 parts; alum, 30 parts; common salt, 35 parts; minium, 100 parts; magnesium, 5 parts. The following are cover enamels (to be superimposed upon the ground enamels). For a leadless cover enamel for cooking utensils, fuse together flint meal, 37·5 parts; borax, 27·5 parts; tin oxide, 30 parts; soda, 15 parts; saltpetre, 10 parts; ammonium carbonate, 7·5 parts; and magnesia, 7 parts. Then grind with flint meal, 6·12 parts; tin oxide, 3·66 parts; soda, 0·7 part; and magnesia, 0·7 part. For cover enamels containing porcelain (1) or glass (2) the constituents may be:—

Material.	1.	2.
Flint meal	25 parts.	6 parts.
Porcelain	25 ,,	—
Silica	—	20 ,,
Powdered glass	—	20 ,,
Borax	25 ,,	24 ,,
Tin oxide	20 ,,	16 ,,
White-lead	20 ,,	3 ,,
Soda	15 ,,	10 ,,
Saltpetre	11 ,,	2 ,,
Ammonium carbonate	7·5 ,,	—
Magnesia	6 ,,	5 ,,

These are ground with

Material.	1.	2.
Flint meal	6 parts.	—
Tin oxide	3·75 ,,	4 parts.
Soda	0·75 part.	1 part.
Magnesia	0·8 ,,	1 ,,

Pewter.—Pewter is a greyish silvery alloy of tin and lead, though other metals may be added or may replace the lead. A greater quantity than 20 per cent. of lead gives a bluish colour to the alloy, which is hardened by the addition of antimony. Whilst the metals are being melted together the contents of the crucible are stirred with a strip of tin and zinc alloy, or a lump of zinc is placed on the surface of the molten metal. This "cleanses" the alloy, that is, prevents the formation of dross. The table below gives the proportions and ingredients of the principal pewter alloys:—

Name or Class of Pewter.	*Antimony.*	*Bismuth.*	*Copper.*	*Lead.*	*Tin.*	*Zinc.*
Ordinary	—	—	—	18	82	—
Better	7	—	4·5	—	88·5	—
ditto	7	—	2	—	89	—
ditto	—	—	8·25	11	78	2·25
Superior	14·5	—	—	—	85·5	—
Hard	7·55	—	1·88	—	90·57	—
Aiken's	7·14	—	3·57	—	89·29	—
Plate	6·9	3·45	3·45	—	86·2	—
ditto	7	2	2	—	89	—
Trifle	17	—	—	—	83	—
Ley	—	—	—	20	80	—

Pewter is chiefly worked by hammering, or the metal is melted and cast into moulds, the article being finished in the lathe if its shape admits of such treatment.

Paint for Boats.—The proportions of the ingredients for a paint suitable for boats are white paint 112 lb., raw linseed oil 1¼ gal., spirit of turpentine 1¼ gal., and litharge 4 lb. The boat should be given three coats of this paint, applied thinly, and care must be taken to get each coat thoroughly dry before the next is put on.

Steam Siren. — The principle of a steam siren is simple A perforated disc is made to revolve over a disc similarly perforated which is fixed in the tube, the revolving disc being fitted with oblique fans; the steam pressure being thus cut off intermittently causes the sonorous vibrations, which, following each other in quick succession, produce a shrill note.

Photographing on Porcelain and Watch Dials.— There are many processes by which photographs may be printed on porcelain and watch dials, but the following is recommended, as it gives any tone from the very warmest sepia to dead black and white or even to blue-black. Porcelain plates can be obtained from any dealer in photographic requisites, and have a matt surface on one side and a high gloss on the other; either side may be used. They must be cleaned carefully, for which purpose scour them with a paste of bicarbonate of soda and water, and then go over the plates with a tuft of cotton moistened with a solution of 1 dr. of nitric acid in 2 oz. of water. Polish the plate with a chamois leather, and, if the plate is perfectly free from dust and finger-marks, dip in olean water, and flow albumen over it. To prepare the albumen, place the white of one egg and 2 oz. of water in a bottle, drop in some fragments of glass, and shake for several minutes; the glass cuts the white of egg and causes it to mix with the water more thoroughly. Drain the albumenised plate into a sink and then flood it again, this time catching the drainings in the bottle. The drainings from the first flow are weakened by admixture with the water on the plate, and are not saved. Dry the plate over a hot-box similar to the one described in Series I., p. 26. The plate is then flooded with an emulsion made by adding together the following stock solutions:—

Stock Solutions.—No. 1.

Alcohol	3½ oz.
Ether	4 oz.
Gun-cotton	60 gr.
No. 2.	
Nitrate of silver	60 gr.
Distilled water	½ dr.
No. 3.	
Chloride of calcium	16 gr.
Alcohol	2 dr.
No. 4.	
Citric acid	16 gr.
Alcohol	2 dr.

Add No. 2 to No. 1 in about four additions, shaking well after each addition, and then add No. 3 and No. 4 in the same way. The plate is dried over the hot-box, and then is ready for printing, this process being practically the same as when printing on sensitised paper. Pleasing effects are obtained by having a white border round the porcelain. To obtain this, cut an opening 3 in. by 5 in. in a piece of opaque paper, 6½ in. by 4½ in., and place this between the porcelain and negative when printing. As the porcelain is not flexible, it cannot be examined whilst printing, and so the time must be gauged by examining a piece of ordinary P.O.P. exposed beneath a negative possessing as nearly as possible the same depth and colour as the one over the porcelain. The pictures can be toned either in sepia or black and white; for the latter, they are printed darker than for sepia toning. For sepia, print to the same depth as any glossy paper is done that is to be toned in a gold bath. For platinum tones, print deeply and until the high lights begin to tint. Wash the printed plate in five changes of water, or for about five minutes if held under the tap. Tone to the required sepia tint in the following gold bath, but in all cases the high lights should be cleared up:—

Gold bath:—	
Distilled or ice water	40 oz.
Gold	¼ gr.
Salt	½ teaspoonful

To this add enough of a saturated solution of borax to turn the bath alkali in about four minutes; test the bath with litmus paper. After this toning, wash under the tap for about three minutes, and then, if a platinum tone or a black and white effect is desired, tone in a platinum bath made up from the following stock solution:—

Stock solution of platinum:—	
Platinite	15 gr.
Phosphoric acid (50 per cent. solution)	2½ dr.
Water	2 oz.

In making up this platinum toning bath use 40 oz. of water and 2 dr. of platinum stock solution. Tone the plates in this until all red has disappeared from the shadows; test the plates by holding them between the eyes and a strong light, when any redness will be apparent at once. Wash for about three minutes after the toning and transfer to the hypo fixing bath, which must be at 25° B. If too weak it will not fix the plates, and if too strong it will bleach them. Keep the plates in the fixing bath for not more than fifteen minutes, and then wash in running water for an hour, or in sixteen changes of water each lasting for five minutes. In printing on watch dials identically the same process is employed; and for printing on fabrics such as silk, satin, or linen the only variation in the process is that albumen is not used in the initial stages. Narrow gilt frames of ¼-in. moulding with ornamented corners are suitable for the porcelain pictures.

Glazing a Greenhouse.—In glazing a greenhouse it is advisable that the glass should only be bedded in putty, front putty being entirely dispensed with; this is found by practical experience to be the better plan. Well paint the rebate with lead and oil, then run a layer of putty made from whiting and boiled oil, to which a little red lead may be added. Cut the glass in tight to size, well rub down into the putty, and force in sprigs along the edges, after which give the edges and rebate three coats of good oil colour.

Batteries for Electric Bells. — The following is a table of the sizes, voltage, and internal resistances of the cells in common use for working electric bells. E.M.F. indicates electro-motive force in volts; I.R., internal resistance in ohms.

Type.	*Size.*	*E.M.F.*	*I.R.*
Leclanché (ordinary)	Pint	1·6	1·5
ditto	Quart	1·6	1·1
ditto	3-pint	1·6	·75
Leclanché (agglomerate)	Pint	1·55	·8
ditto	Quart	1·55	·6
ditto	3-pint	1·55	·5
Leclanché (six-block agglomerate)	—	1·55	·2
Leclanché (carporous)	2½ in. by 5½ in.	1·5	1
ditto	3 in. by 6½ in.	1·5	·75
ditto	3½ in. by 7½ in.	1·5	·5
Leclanché (Victoria)	—	1·55	·3
ditto	Large size	1·55	·12
Edison-Lalande (circular)	3½ in. by 7 in.	·75	—
ditto	5½ in. by 8 in.	·75	·012
ditto	5½ in. by 11½ in.	·75	·03
ditto	6½ in. by 10 in.	·75	—
ditto	7 in. by 18 in.	·75	—
Edison-Lalande (oblong)	4½ in. by 4½ in. by 7½ in.	1·5	—
Daniel (gravity)	3-pint	1·08	3
ditto	3-quart	1·08	1·6
Daniel (quantity)	—	1·08	2
E.C.C. or Burnley (dry, circular)	2 in. by 5½ in.	1·55	·85
ditto	2½ in. by 7 in.	1·55	·7
ditto	3½ in. by 8 in.	1·55	·35
E.C.C. or Burnley (dry, oblong)	1½ in. by 1½ in. by 2½ in.	1·55	—
ditto	1½ in. by 1½ in. by 4½ in.	1·55	·95
ditto	4½ in. by 2½ in. by 6 in.	1·55	·3
Gassner (dry, circular)	3 in. by 7 in.	1·47	·4
Gassner (dry, oblong)	1½ in. by 3½ in. by 7½ in.	1·47	·4

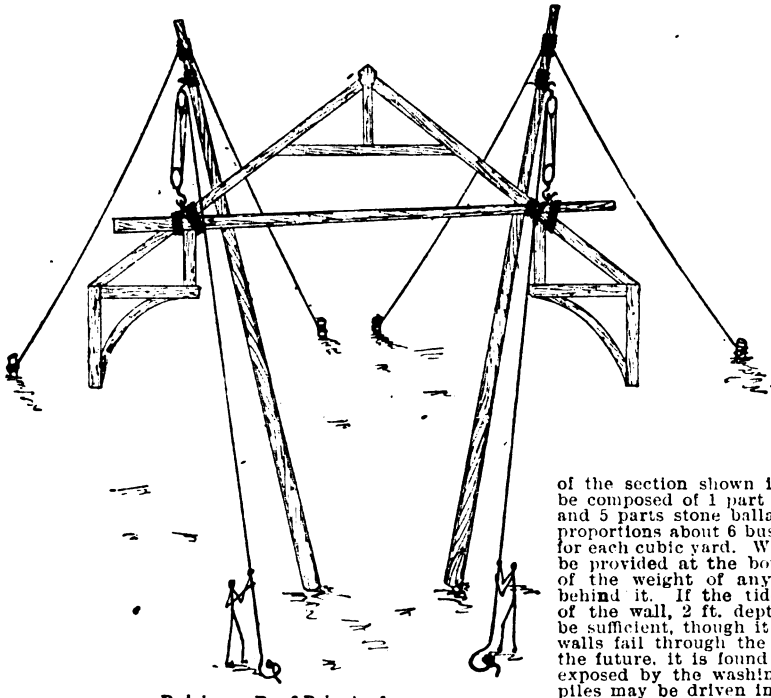
Red Putty.—Reddish putty contains red lead; it sets very hard and is very durable, but is not used for ordinary glazing owing to the extra cost. Red putty is used chiefly by hot-water engineers and boilermakers for making joints.

Barytes.—Barytes, or heavy spar, is the native barium sulphate, and (though it has not sufficient opacity to be used alone) it is used to a large extent in paint-making either normally as a constituent of some particular colour, such as Freeman's white, Orr's white, etc., or as an adulterant, usually of white-lead. Barytes is also used as a white colour by paper stainers, and as one source of the barium salts.

Glass Draughtboard.—In making a fancy draughtboard on glass one method is first to gild the glass all over, then cut a stencil of the draughtboard, lay the stencil on the gold, and with a moderately stiff brush, such as a hat brush, brush out the intermediate squares. Back the glass with drop black ground in turps and bound with varnish. When seen from the reverse side of the glass the appearance is very rich. (For gilding glass see Series I., pp. 125, 146, and 339.)

Fixing New Washers on Hot-water Taps.—Washers can be put on hot-water taps while the fire is alight (provided the fire is low) if the taps are a few feet above the boiler. The apparatus must be emptied down to the tap, and this should leave a few feet of pipe and the boiler full of water. If the fire is low, the water in the pipes cannot be evaporated in a quarter of an hour, and this is quite long enough to secure a tap if its upper part is first loosened and comes off easily. A tap might be re-washered without emptying the apparatus if the expansion and cold supply were soundly plugged to prevent air getting in, but it must not be forgotten to unplug the pipes afterwards, before the fire is brightened up. In good work a stop-cock should be put behind every draw-off cock to admit of the latter being attended to without interfering with the apparatus and other taps generally.

Raising a Roof Principal.—In raising into position a one-ton roof principal two upright poles may be used, and a horizontal pole, as indicated in the figure, should be securely lashed to the principal to prevent its being strained during the operation of hoisting. Treble-sheave blocks will be ample for the purpose, seeing



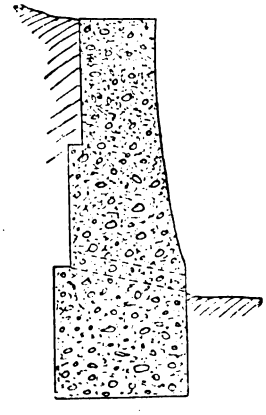
Raising a Roof Principal.

that each rope will only have to lift about half a ton; if double-sheave blocks are used, the time occupied in hoisting will be lessened, but more than one man must pull at each rope. A 3½-in. good quality hemp rope will lift 11 cwt. easily with an ample margin of safety.

Dyeing Heald Rugs Black.—As the heald rugs will most probably contain oil, they should first be thoroughly washed in clean soap and water, followed by a thorough cleansing in clean water. Two vats will be wanted for dyeing. In one boil 5 lb. of logwood chips in 1 gal. of water, strain, and dilute to 1½ gal. In the other vat dissolve 4½ oz. of bichromate of potash and 1½ oz. of strong sulphuric acid in 1 gal. of water. The heald rugs must be boiled one hour in the bichromate solution, then boiled one hour in the logwood vat. The above materials will yield a blue-black colour. For a "dead" black, put 8 oz. or 10 oz. of old fustic with the logwood.

Alabaster Polishing.—Alabaster is considerably harder than Bath or Caen stone, although worked similarly—namely, with steel toothed saws, and steel drags of varying degrees of fineness, first the coarse, next the second, and then the fine drag being used. The surface left by the drags is rubbed with coarse sandpaper and then with fine sandpaper, until all the marks of the drag are removed and an even, smooth face is produced, all these operations being done in the dry. The surface is next grounded with stone grits and water, as in marble polishing, but the grits in this case are used flat instead of on edge. The grits mostly employed are seconds and snake (water of Ayr), which are sometimes pounded up and used on a worsted wad or boss, the seconds grit first and then the snake. Then mix in equal proportions powdered sulphur and French chalk, and use on the boss moderately moistened with water, working uniformly over every part, and finally finishing with putty powder (oxide of tin). A little sweet oil afterwards rubbed on heightens the polish and brings out the gradations of rich colouring. The polishing of alabaster is a process that can be accomplished successfully only by those who have had experience in marble polishing. The beginner should practise on waste pieces of alabaster before attempting to polish anything of value.

Concrete Sea Wall.—In constructing a sea wall of concrete, assuming it to be a retaining wall



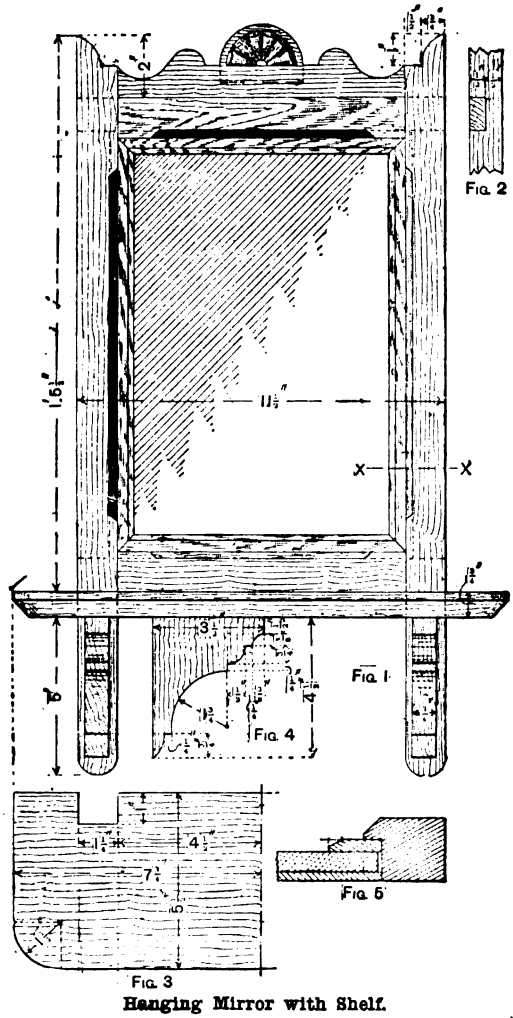
Concrete Sea Wall.

of the section shown in the figure, the concrete may be composed of 1 part Portland cement, 2 parts sand, and 5 parts stone ballast of 2½-in. gauge. With these proportions about 6 bushels of cement will be required for each cubic yard. Weep-holes, say 10 ft. apart, should be provided at the bottom of the wall to relieve it of the weight of any water which may accumulate behind it. If the tides very seldom reach the foot of the wall, 2 ft. depth of foundation will probably be sufficient, though it must be remembered that most walls fail through the toe being washed away. If, in the future, it is found that the foundations are being exposed by the washing away of the beach, a row of piles may be driven in front of the wall to protect it. At Westgate, in Kent, a sea wall was built on the chalk with 2 ft. depth of foundations, and in two or three years portions of it were completely undermined. In this case, however, high water of ordinary spring tides reached 4 ft. or 5 ft. up the wall.

Lime Deposit in Hot-water Pipes.—The incrustation in the interior of hot-water pipes is caused by the deposition of the lime contained in the water that passes through the pipes. As soon as the water boils, the lime is precipitated in the form of a fine powder, and the heated metal on which this powder is deposited causes incrustation. When the water is free of lime incrustation does not occur; one preventive measure, therefore, is to remove the lime from the water before it enters the hot-water apparatus. Such a proceeding is possible, but as the supervision of the necessary plant would demand one man's whole time and attention, such a plan can only be adopted in very large houses or business places. This is the only preventive measure that can be adopted at the cold water cistern. Other methods of preventing incrustation are to proportion the apparatus so carefully that although the water gets hot it seldom boils. Another plan is to use the largest possible pipes, so that the deposit gives no trouble for a long period. It is usually considered that if the boiler is cleaned regularly the pipes will remain clear for a longer time than would otherwise be the case.

Coppering Brass.—In treating lacquered brass so that it will have the appearance of copper, first the brass must be boiled in a strong solution of soda to remove all lacquer and dirt, and then polished and washed clean. Now get a roll of fine iron wire; in the centre of this place the articles and dip in a vessel containing dipping acid: dipping acid may be diluted sulphuric acid. Then wash off and lacquer in the ordinary way.

Hanging Mirror with Shelf.—The hanging mirror illustrated by Fig. 1 has a framework 1½ in. wide and 1 in. thick, the shelf and support being ¾ in. thick. The four joints are ordinary half-laps (see Fig. 2), and the glass measures 13½ in. by 9½ in. The shelf (see Fig. 3) has two notches that fit the two upright sides, and is secured to the bottom rail by three screws. The inside edges of the frame are stop-chamfered. Fig. 4 shows the setting out of the support, and Fig. 5 a



Hanging Mirror with Shelf.

section on X X (Fig. 1). Any measurements not given may be obtained from the illustrations, which are drawn to scale.

Stone Spires to Towers.—Following are instructions for building of dressed rubble walling a church spire 50 ft. high, octagonal on plan, the cant side being 8 ft. at base. It is unusual for a spire 50 ft. in height to be perfectly straight; an entasis is, more often than not, shown, and should in this case have a rise of about 4 in. from the chord line, the contour being a flat segment of a circle. The object of this almost imperceptible swelling is to correct an optical illusion; if the sides of the spire are perfectly straight, they will appear to be concave or hollow. Set out the vertical and horizontal sections of the spire, full size, on a floor or on a temporary platform specially constructed for the purpose. One half only of the spire from the centre line to the outside need be shown, as the other half is a repetition of the first. Presuming that the quoins are in dressed stone, the beds and joints to each course must be shown, in order to make the moulds (which are cut from sheet zinc); the plain face of dressed rubble forming the filling in between the quoins may be bonded in as required when building, no moulds being necessary. The bed joints of the stones are usually cut at right angles to the sloping face or inclination of the spire, but horizontal beds are supposed not to involve so much thrust at the base. To obviate any outward tendency, a chain or rod-bond, united at the angles, and inserted in a cavity at the base of the spire and well bedded in Portland cement or lead, is sometimes used. The thickness of the work will depend chiefly on the height of the spire and the quality of the stone. From 10 in. or 12 in. at the base, diminishing to 6 in. or even less at the top, may be generally considered sufficient in cut stone; but in rubble work this thickness will have to be increased, and the diminution will be in regular offsets. It may, perhaps, be of interest to state here that the stonework of the spire of Salisbury cathedral (the spire, reckoning from the tower, being 204 ft. in height) is 2 ft. thick at the base, and gradually diminishes in thickness to a point about 20 ft. above the tower, where the stonework is reduced to 9 in. and is continued at that thickness to the capstone at the summit. In fixing or setting the stones, the chief factor is an accurate plumb-rule made to the line of slope of the face of the spire; but the correctness of the work must be tested from time to time, both by trying the length of the diameter of the spire (taken from the full-size setting-out on the board) at the course where the fixing is in progress, and by dropping plumb-lines from each side upon a base; a permanent point also should be fixed on the floor in the square part of the tower as axis of the spire, to which a plumb-line or centre-bob may be dropped from the scaffolding above. By this means any irregularity would be at once detected, and it is only by repeated testing, or trying-up, that the accuracy of the work can be maintained. The scaffold should be the ordinary masons' scaffold, and consist of poles forming the standards and horizontal ledgers, putlogs for the cross-pieces, boards for the platform or stage, and cords for lashing. The general construction of such a scaffold should be stronger than in a bricklayer's scaffold, because heavier materials are used. As it is not always possible or convenient to insert the putlogs into the tower, double standards must be fixed in two parallel rows, one about 1 ft. from the tower, the other about 5 ft. beyond, with pole ledgers tied horizontally to support the putlogs. Where windows or openings occur in the tower, advantage must be taken to run pole ledgers through in order to secure and steady the scaffolding. Above the tower the scaffold must be quite independent of the spire, and must not touch it in any way; the whole scaffold should be well braced, lashed, and wedged, and each part so arranged as to ensure the firmness and stability of the whole. The hoisting gear will depend chiefly upon the weight that has to be lifted; a stout pole gib run out with a one- and a two-sheaved block, and good rope fall worked with a crab, should be sufficient. A considerable part of the material may be brought up inside the tower and spire, until the gradually converging walls of the spire so reduce the space that such a course becomes impracticable.

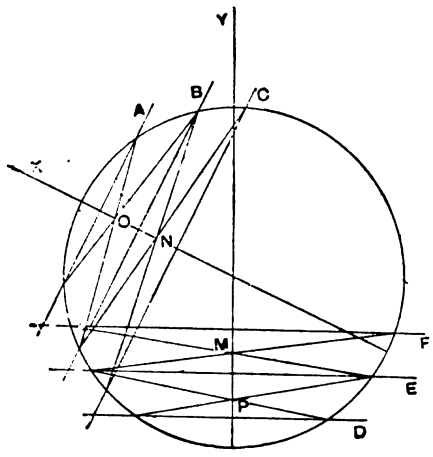
Waterproofing Cloth with Resin Soap.—Cloth waterproofed with resin soap is stiffer than that with which the ordinary alumina soap has been used. The resin soap is made by dissolving ½ lb. of washing soda in 1 gal. of water, and then boiling it with 1 lb. of finely powdered pale resin. The resin soap solution must be added to the ordinary soap solution, the alum solution (Series I., p. 80) remaining as before. A resinate of alumina will be formed; this is harder, and will take a better gloss than will the ordinary alumina soap used in the general process of waterproofing. A slight trace of ultramarine added to the soap solution will give a whiter product. See also Series I., p. 80.

Shiny Spots on Photographic Print.—Shiny spots on photographic prints that have been given a matt surface by squeegeeing on to ground glass are due to air bubbles that were imprisoned between the print and the glass during the process of squeegeeing. There is less chance of these air bubbles forming if the glass and the print are brought into contact under the surface of the water, but as such a procedure is not always convenient, special care must be exercised in laying the print on the glass. Any print that is disfigured with shiny spots should be soaked in water and squeegeed again.

Soldering Galvanised Iron.—To ensure the adhesion of tin when soldering galvanised iron or steel, first thoroughly tin the copper bit. File it quite smooth and clean, and dip the nose of the bit in chloride of zinc (killed spirit); melt a little tin on the cleansed part, and then rub each of the four faces of the bit on a lump of sal-ammoniac until the tinning is completed. When soldering galvanised iron or steel, hydrochloric acid (raw spirit) is used as a flux; this is applied to the part to be soldered with a small brush, or with a piece of cane. The part is then soldered with the bit in the usual manner.

Patching Fireclay Parts of Smelting Oven.—The best mixture for mending the fireclay parts of a small smelting oven is one made of 2 parts of fireclay and 1 part of finely powdered firebrick or clean old melting pots. If these are mixed together in the dry condition, and the mass is tempered with just sufficient water to render it plastic and then left for a week, it will be in the proper condition. It should be applied as dry as possible compatible with proper working; the more water there is in the clay the more it will shrink on drying and the greater will be the tendency to crack. If large holes are to be patched the clay will probably crack on drying, but the crack should be again patched with more clay.

Finding the Centre of a Circle.—The accompanying illustration shows a method of finding the centre of a circle, using only a parallel rule and a pencil. First draw the line A, and, keeping the rule in the same position, draw B. Then draw C parallel to B. Join the points where A, B, and C cut the circle, as shown in the illustration. Then draw D, E, and F in



Finding the Centre of a Circle.

the same way as for A, B, and C. Draw X through O N, and Y through M P, and where X and Y meet is the centre of the circle.

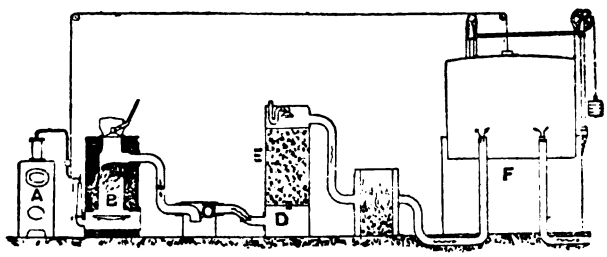
Curing and Dressing Moleskins.—In curing and dressing moleskins, mix ½ pt. of salt and 1 oz. of best oil of vitriol in 3 qt. of soft water. Stir this with a stick, then place the skins in it for thirty minutes. Squeeze, but do not wring them, then hang them in the shade to dry. During drying the skins should be kept stretched straight. When nearly dry they should be rubbed with a piece of pumice-stone until quite dry.

Stretching Wire-rope Bridge.—In stretching a wire-rope bridge across a river the ends of the wire to be strained together are fitted with rods tapped the one with right- and the other with left-handed screw threads. A long link is furnished with a boss at its head and tail; these bosses are tapped to fit the rods, so that by turning the link in one direction the ends of the wire are drawn together. The straining distance is, of course, very limited, but suitable for any final straining or adjusting of tension.

Nickel-plating without a Battery.—To deposit a coat of nickel on the surface of another metal without the aid of a battery, it is necessary to have a solution or paste of a nickel salt containing an acid that will dissolve a portion of the metal to be coated at the same time as it sets free some particles of metallic nickel. There must be chemical action on the metal, and a decomposition of the paste by an interchange of metal. The coat will, therefore, be weak and unreliable. It will also be very thin, because all action of the free acid ceases when a thin coat has been deposited. Copper may be coated thinly with nickel in a solution of the double chloride of nickel and sodium. A coat of nickel may also be obtained in any nickel-plating solution by attaching a lump of zinc to the article being plated, thus making them a pair of electric elements, and contaminating the solution with zinc. Fictitious coats of nickel have also been secured from an amalgam of mercury.

Air-proofing Canvas for Tyres.—Canvas is "proofed" in the usual way by coating it with a thin layer of indiarubber which is afterwards vulcanised. The rubber is dissolved in benzine to form a thin paste, the canvas is unwound from a roll in a machine to which the rubber paste is fed, and the latter is spread evenly over the canvas by means of a knife. The coated canvas passes over a steam chest to remove the benzine, which is usually recovered, and it is afterwards cured by running the rubber face through a solution of sulphur chloride in carbon bisulphide.

Plant for Making Fuel Gas.—The two methods for the manufacture of fuel gas are the Dowson system and the water-gas system. The plant employed in the Dowson system consists of a steam generating boiler A (see illustration herewith), generator B charged with anthracite coal or coke, an hydraulic seal C, coke scrubber D, sawdust scrubber E,



Dowson Gas Plant.

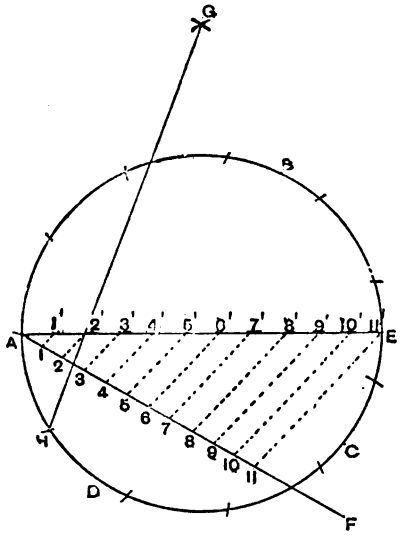
and gas-holder F. The gas produced by this apparatus has the following volume composition: Carbon dioxide (CO_2), 6·3 per cent.; carbon monoxide (CO), 23·8; marsh gas (CH_4), 1·3 per cent.; hydrogen (H_2), 19·8 per cent.; nitrogen (N), 48·8 per cent.; the combustible gas amounting to 44·9 per cent. One pound of anthracite gasified in the generator and 0·18 lb. coke in the boiler yield about 81 cub. ft. of gas, having a calorific value of 164 British thermal units per foot. This gas is extensively employed in gas engines, but would not be so suitable as water gas for incandescent burners. The plant employed in the production of water gas embraces the generator, carburetter, superheater, condenser, together with a boiler for supplying steam, fan for air-blast, and exhauster.

Ferozone Process of Sewage Treatment.—Ferozone is a chemical compound, consisting mainly of sulphate and magnetic oxide of iron; it is rich in ferrous iron, alumina, and magnesia, as well as magnetic oxide of iron in a very spongy and absorptive condition. It is used as a precipitant, being mixed with the sewage in the proportion of 8 gr. of ferozone to 1 gal. of sewage; after standing from one to three hours, and all solid matters being precipitated, the tank effluent is purified by being passed through "polarite" filters. The addition of ferozone to sewage is not the whole process, but only one step in the process of purification.

Cutting and Polishing Clock Pinions.—In cutting clock pinions some makers use one cutter to cut the spaces and form the leaves as in brass wheel cutting, others slot the pinion with a saw cutter and round the leaves with another. The latter method saves some wear and tear on the expensive cutters. A separate cutter is required for each pinion of six, seven, eight, or ten teeth to run with the same wheel, as a scale drawing of the pinion enlarged four times would readily show to the eye. After being hardened, the pinions, if true, are polished by oilstone dust and oil, or by fine emery and oil on a soft wood disc run in the cutting engine or lathe. This is followed by red-stuff and oil on a similar disc. But for a regulator pinion, where perfect truth is required, the leaves, after being hardened, are lapped true in the cutting engine by soft steel laps formed like the cutters, and charged with oilstone dust and oil, and red-stuff to finish.

Sal-soda.—Sal-soda is the ordinary carbonate of soda, and is now manufactured from common salt on a very large scale. The salt is heated in pans with strong sulphuric acid yielding sulphate of soda and hydrochloric acid. The sulphate of soda is mixed with limestone and coal and heated in large revolving furnaces; after the reaction has ceased the melted mass is turned out and, after cooling, treated with water, the solution being evaporated to dryness, and heated in a furnace, yielding impure carbonate of soda or soda-ash. The soda-ash is further treated for the preparation of the pure carbonate of soda.

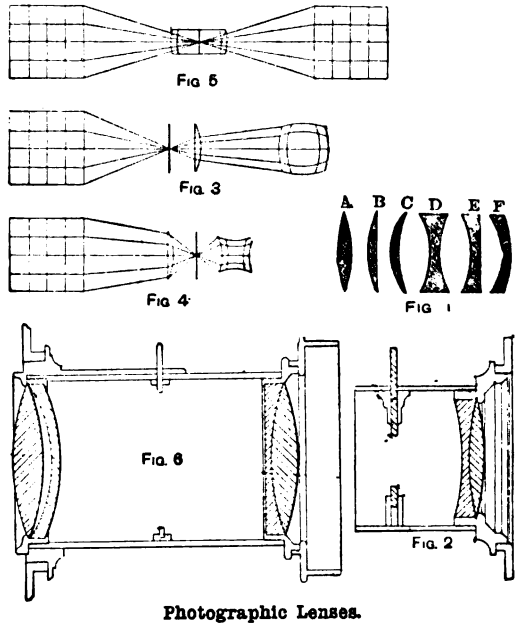
Dividing Circle into any Number of Equal Parts.—The following is a general method of dividing a given circle into any number of equal parts. Let A B C D be the given circle. Divide a diameter A E into as many equal parts as there are to be divisions in the circumference of the circle (in this case eleven). This is done as follows. Draw a line, such as A F, of indefinite length, and making any E A F angle with A E. Take any convenient length of line, such as A 1, and step it off with



Dividing Circle into any Number of Equal Parts.

dividers eleven times on the line A F in the points 1, 2, 3, etc. Join the eleventh point with the end E of the diameter, and then draw parallel to 11 E the lines 10 10', 9 9', etc.; the diameter A E will thus be divided into eleven equal parts. With A and E as centres, and A E as radius, describe two arcs intersecting each other at G. Join G with the second point (2') in the diameter A E, and produce G 2' to meet the circumference in H. The arc A H is the eleventh part of the circumference. Therefore, take the distance A H with a compass and step it off on the circumference. Great accuracy must be observed, otherwise satisfactory results will not be obtained.

Lenses.—All lenses partake of the forms shown in the six elementary examples (Fig. 1). A, B, and C are "positive" lenses, or lenses that form real images, and D, E, and F are "negative" lenses, incapable of forming real images, but capable of forming virtual images or of altering those formed by a positive lens. The surfaces of A, B, and C bend outwards in the centre, whilst the surfaces of D, E, and F are thinner in the centre. Photographic lenses may be classed under three principal divisions, namely, the "single," the "rapid rectilinear," and the "portrait," nearly all other lenses being variations of the lenses bearing these names. The single lens is shown in Fig. 2, and consists of a negative and of a positive element (the one being of crown and the other of flint glass) cemented together with Canada balsam. For when a ray of white light passes through a simple lens its component colours are separated, but may to some extent be re-united by allowing the rays to pass through a lens of different formation. Such a lens is called achromatic. By using glass of different densities or of refractive index, but of similar dispersive power, the rays may be re-united without destroying the refraction (see Series I., p. 327). Single lenses produce distortion, causing, for instance, square objects to be represented of the shapes shown in Fig. 3 or Fig. 4, the particular kind of distortion depending on the position of the stop either before or behind the lens. The lenses are chiefly used for landscapes, but the better kind may be used for portraiture if rapid plates are employed. The aperture of the lens is generally *f*/11·3. The doublet or rapid rectilinear, also called rapid rectigraph, etc., shown in Fig. 5, has two components similar to Fig. 2, and here the distortion of one lens should exactly counteract that of the other, the result being rectilinearity. When both components are of the same form and focus the lens is sometimes called a rapid symmetrical. Such lenses usually work at *f*/8. The portrait lens (Fig. 6 shows the Petzval or general form) is a rectilinear lens of special construction designed to give fair definition over a small area with a very large stop. The lenses generally show considerable spherical aberration and curvature of field, but work at as large an aperture as *f*/2·5. Portrait lenses are also suitable for enlarging and for lantern projection. It will be seen that the rapid rectilinear lens has generally twice the rapidity of the single lens, but the portrait



Photographic Lenses.

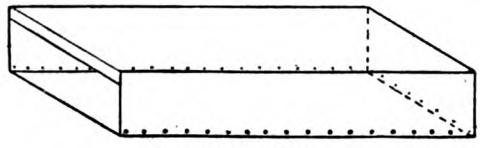
lens may be nearly sixteen times as quick as the rapid rectilinear lens. These proportions, however, are only approximate, as the *f*/ ratio is dependent upon the general qualities of the lens. Little alteration has been made until late years in the principles of construction, but by the introduction of Jena glass of a different density to that hitherto obtainable, and having in consequence a different refractive index and dispersive power, it became possible to produce an objective possessing greater covering power, a flatter field, and freedom from stigmatic aberration, together with increased rapidity without increasing the *f*/ ratio. Perhaps the best example of this is the Goerz lens made by Goerz & von Hoegh. The lens consists of a symmetrical doublet, each component being formed by enclosing a negative lens between two positive elements, one of which has a higher and the other a lower refractive index than the negative lens. It includes an angle of 70° whilst giving a field free from astigmatism. Other modern improvements appear in the Zeiss & Cooke lenses, the latter being practically a triplet, *i.e.*, each having three separate components. The system is corrected by the centre component, which is a negative lens of high dispersive power. It works at *f*/6·5. There are many other points concerning lenses, but they cannot be dealt with here.

Polishing Watch Balance-staffs.—To polish a watch balance-staff after turning the staff as smooth as possible with a sharp graver, treat it with oilstone dust and oil on a flat steel polisher. When all turning marks have been smoothed out, clean and re-file the polisher, and apply it again with redstuff and oil (a kind of rouge) in the same way as with the oilstone dust. This will bring up a brilliant polish.

Polishing Tin-plate Ware.—A cheap method of polishing common tin-plate ware is the following. First scour the surface of the ware with a greased rag mop attached to the nose of the shaft of a polishing lathe; then clean bright with a dry mop dusted over with Sheffield lime. The lathe should be run just fast enough to cause the linen mop to stand out stiff; the tinned surface will then undergo no deterioration. If a polishing lathe is not available, make a thin paste from the finest flour emery and paraffin, and, using a pad of ordinary house flannel, scour the metal clean; then dust over with whiting, and clean up bright with an ordinary duster. If the articles are not required very bright, they may be dusted over with whiting, and then cleaned as above, the preliminary scouring being omitted.

Sawing Marble Slab.—For cutting in two a marble slab a grub-saw and sand are necessary. To make the saw, obtain a piece of hoop iron about 15 in. or 18 in. long, fix it in a saw-cut in a piece of wood (a piece of thick broomstick will do for this), and notch the outer edge of the iron by hacking it with the edge of an old file. Mark where the slab is to be cut, sprinkle some sharp clean sand on the mark, and wet it well. Then move the saw to and fro on the marked line and constantly feed the groove with sand and water until the slab is cut through.

Lacquering Stove.—A lacquering stove heated by gas might be made as follows. Obtain a sheet of iron ⅛ in. thick, 3 ft. long, by 2 ft. 6 in. wide. Mark 6 in. margin all round, and bend down, except one side, (see illustration), this side being only 1 in. deep. Cut

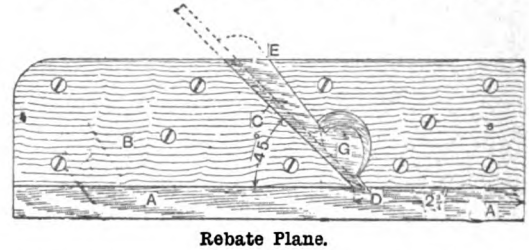


Lacquering Stove.

another piece 2 ft. 2 in. by 2 ft., and bend it up in 1 in. round three sides. Place this piece on the bottom of the other piece, and rivet the two together; this will make a shallow iron box 2 ft. square and 6 in. deep. The burner may be either round or rectangular. Fletcher's triple concentric burner is a good one; it allows of three separate heats. It must be lighted and placed inside the box, care being first taken that the airway to the burner is outside, so that the air to the burner may not be impeded. A stove of this description will give excellent results. The stove can stand on a pair of light iron legs; or a table might be made of light angle-iron framing.

Cleaning Gilt Work.—If an English oil- or water-gilt surface is rubbed constantly with water to remove dirt, the gold also, after a time, will come away; therefore, in cleaning a gilt surface it is necessary to apply something that has a quick action. Brush off loose dirt, and brush on clean water to all unburnished parts; constantly change the water. Soft hog-hair tools and camel-hair pencils are used to apply the water. All dust and fly marks now should have been removed, and the work must be left to dry. Obstinate marks should be wiped over with a camel-hair pencil charged with a mixture made in the proportion of 1 oz. of methylated spirit and ½ oz. of ammonia to 1 pt. of water. Rinse the brush in clean water each time it is removed from the work, and squeeze out before re-charging with the mixture. The quicker this part of the work is done the better, and the brush should not be passed twice over parts where the gold may have risen and shows signs of coming off. The burnished portions of the gilt work, if wet has not touched them, may have their appearance improved in a simple manner. Fold a piece of new washleather so that it fits into the burnished hollows, etc.; lightly breathe upon a small surface of the burnish, and at once push or roll away the dirt and dust with the washleather. Fly marks, generally, may be removed in the above manner, but the rubbing must not be continued at the risk of the gold being rubbed off. As a precaution, hang a tissue-paper screen between the work and the source of light, and this will show whether the operator is rubbing through into the burnished gold-size. Much practice is necessary to avoid taking off the edges of hollows, fillets, etc. Burnished "bubbles" and scrolls are cleaned by gently rubbing with a washleather drawn tightly over the thumb, the gilt work having been breathed upon previously. Cleaned gilt work may be sized to improve its appearance; for ornamental parts, use clear size; for plain parts, ormolu size. Gilders' ormolu size or varnish is made by dissolving 1 oz. of shellac and 1 oz. of elemi in 1 pt. of spirit, or by dissolving 1½ oz. of shellac and a tablespoonful of powdered gamboge in 1 pt. of spirit; strain before using. The following is a good method of cleaning gilt frames and ornaments. First carefully dust the articles to be cleaned. Then dissolve a piece of cyanide of potassium, about the size of a hazel nut, in 1 pt. of water, and with a fine sponge wash the gilding with the solution, doing a small portion at a time. Wash each portion thus cleaned with another sponge and clean water, and allow the article to dry. The gilding will then appear as if freshly executed. In cleaning foreign "washable" gilt work, little can be done beyond a thorough brushing with water; obstinate fly marks are removed at the risk of injuring the gold beneath. Marks can be removed from English gilt work without damaging or discolouring the gold leaf, but foreign gilding is destroyed by such treatment, white spots showing where the marks have been washed off. Short of re-gilding, the only remedy is the application of the very best gold paint, but the use of gold paint on articles exposed to the atmosphere is discouraged, because sooner or later it will turn black unless protected by varnish, and the latter spoils the appearance, giving the gold a brassy colour.

Rebate Plane.—The illustration shows a rebate plane, to make which take two pieces of hard wood, one A, 8 in. long by 2½ in. wide and ¾ in. thick, and the other B, 8 in. long by 2 in. wide and just under ⅝ in. thick. To use a ⅝-in. chisel for the blade of the plane,



Rebate Plane.

make B about $\frac{1}{32}$ in. thinner than the blade is wide, and be sure to have the bottom edge straight and square. On it set off the line C at an angle of 45°. Lay the chisel on its edge to this line, as shown dotted, and mark the point D about $\frac{1}{16}$ in. in front of the edge of the chisel; join these points and square the lines down the edges. G is a hollow to allow the shavings to come out. Sketch the outline of this and then screw B to A, as shown. Now saw carefully to the lines at C and D E, and the piece of wood will come out where the chisel and wedge are to go. Do not saw into the piece A. With a gouge hollow out the piece G through B only. Make a wedge to fit, and round off the end for the hand. If the plane chokes the mouth at D, ease the hollow G a little.

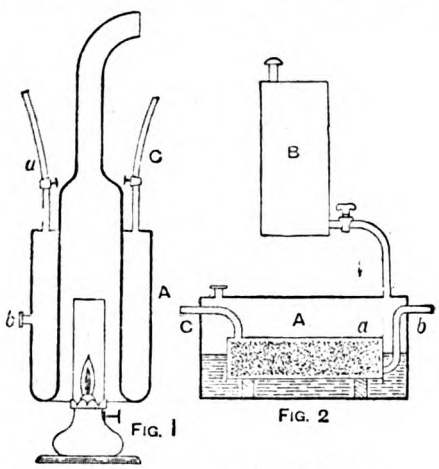
Cleaning and Re-charging Filter.—A 6-gal. earthenware water filter should require about 9 lb. of wood charcoal, or a larger quantity of bone charcoal, which is much heavier. The charcoal should be about the size of a pea, and should be closely packed; do not put a sponge in, as it decomposes after a time. The filter must be cleaned out at least every three months; diluted Condy's fluid should first be passed through until the liquid filters pink, then run water through, and afterwards take out the charcoal and dry it in the sun; then replace it. The charcoal will serve three or four times, and should then be thrown away. Domestic filters remove practically only the suspended matter from water, and unless cleaned often the filtered water may be dirtier when leaving the filter than when it entered.

Manufacture of Golden Syrup.—In the manufacture of sugar, the juice expressed from the cane or beet, after clarifying, is concentrated to a certain strength in a vacuum pan and then run out to cool, when crystals of sugar separate; the liquid from these may be concentrated, and from it another lot of sugar may be separated, but finally it is concentrated to a syrup and forms treacle; it is usually brown or black in colour, and is more or less impure. The crystals of sugar, separated as above, naturally have some treacle adhering which colours them yellow or brown. To produce colourless crystals from these, they are washed with a solution of sugar, the treacle is dissolved off the crystals by this solution, and the wash water, after concentrating in the vacuum pan, forms a pale yellow pure treacle known as golden syrup. It does not pay to make small quantities of golden syrup, owing to the great cost of a solution tank, a vacuum pan, etc.

Cementing Corners of Glass Aquarium.—A good way of securing the corners of an aquarium is to use an angle piece of zinc, and bed the glass in red lead putty. If this is impracticable, butt the glass together and make an angle inside with red lead putty. On the outside angle fix with marine glue a piece of silk or other ribbon, stretching it tightly. The putty must be allowed to get quite hard before the aquarium is used. (For recipes for aquarium cements see Series I., p. 218.)

Sensitising Wood, Paper, and Cloth.—For sensitising wood, paper, or cloth they may be printed on from an ordinary photographic negative. The silver process may be used, although for cloth the platinotype process is rather more suitable. For wood, make a salting solution of ammonium chloride 10 gr., gelatine 20 gr., and water 10 oz. The wood, which should be well seasoned, with a good surface, is supported at the extreme corners on glass blocks or rods, and placed face downwards in the salting solution for about five minutes. When the salting solution is dry, sensitise the wood by immersing it for five minutes in a 45-gr. bath of nitrate of silver. For paper, half the quantity of gelatine given above will suffice, and for cloth use even less, according to the quality and texture of the material to be dealt with.

Carburetter for Small Oil Engine.—Two forms of carburetters for small oil engines are here shown. Fig. 1 consists of an annular chamber A surrounding a lamp, which serves to heat the chamber and also to ignite the



Carburetter for Small Oil Engine.

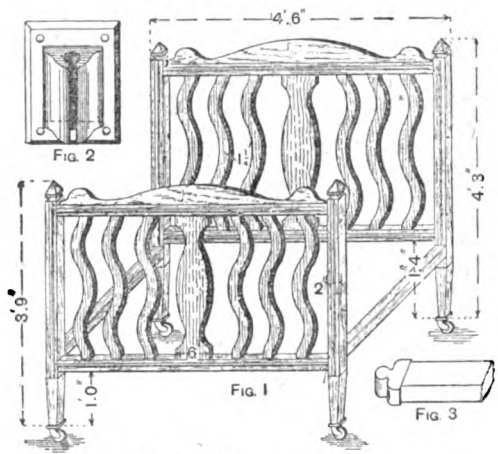
explosive mixture in the cylinder. Oil is conveyed to the chamber by the pipe *a*, while air is admitted by the opening *b*. The air and oil vapour are drawn into the combustion chamber by the pipe C. Either benzoline or petroleum may be used in this form of carburetter. In Fig. 2, A is a small tank supplied with benzoline from the reservoir B. *a* is a small cylinder, perforated with holes on the lower side and loosely filled with cotton-wool; *b* is the entrance-pipe for air, and C the exit pipe for the carburetted air. The level of the liquid in the tank should not be higher than half the height of *a*, or liquid will be drawn over. Benzoline must be used with this form of carburetter. For a very small engine the carburetter should be made rather large, so that plenty of carburetted air may be available. Several pieces of fine wire gauze should be put in the exit pipe, so that the explosive wave may not travel into the carburetter.

Preparing Potash or Pearlash.—In the process of obtaining potash from fresh wood ashes, these are treated with a small quantity of water, which dissolves out the potash salts; the liquid then is filtered and evaporated to a small bulk, when the greater part of the salts, such as sulphate, etc., crystallise out, leaving the carbonate of potash, which is very soluble, in solution. This solution is evaporated to dryness and ignited, yielding pearlash, or the ordinary potash of commerce. Caustic potash is made from this by dissolving it, and treating with lime; after decanting the clear liquid, it is evaporated to dryness, fused in iron pans, and cast in iron moulds. Potash is also made from beetroot molasses, which is first fermented and the alcohol obtained from it; the residue is then evaporated and treated as above. Other salts of potash, such as sulphate and chloride, are now largely converted into carbonate by chemical means.

Acid Solution Cement for Paper.—In cases where glue or paste cannot be used for sticking two pieces of paper together, an ammoniacal solution of cupric oxide might be tried. This may be made by precipitating a solution of copper sulphate with caustic soda, collecting the precipitate on a cloth, and, after washing once or twice with water, dissolving it in strong ammonia. This solution dissolves cellulose, and if applied to paper softens the surfaces so that two pieces when pressed together will become practically one.

Using Watch Screw-plate.—When using a watch screw-plate, lubricate it freely with oil. To ensure good lubrication, screw the wire in half a turn, then back a quarter, in another half a turn, and so on. If this is done the threads will be cut clean. It is, perhaps, best to use the plate with the numbered side uppermost. The two rows of holes are exactly alike in size. If one hole becomes choked with brass, drill it out and insert a suitable tap to clear the thread.

French Bedstead in Wood.—Fig. 1 shows a design for a French bedstead 4 ft. 6 in. by 6 ft. 6 in., having posts 2 in. square, with a square knob worked on the top; or separate turned knobs could be fastened with a dowel. The cross-rails, 2 in. by 1½ in., are stump-tenoned into the posts; they



French Bedstead in Wood.

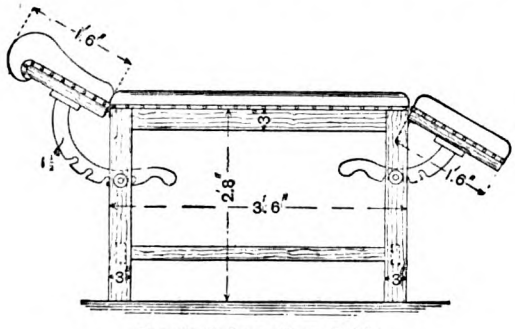
must not be secured until the sawn uprights are ready for fixing. The pediments, 4 in. and 4½ in. deep, are fixed with three dowels; the steads should be mounted on a set of pin casters. Birch stained a walnut colour or ash stained a green colour would be suitable, or the job could be done in American walnut or mahogany if required to match the surrounding furniture. The iron sockets (Fig. 2), rails (Fig. 3), and the stretchers cannot be home-made.

Tinning Small Iron Articles.—The articles should be pickled in warm sulphuric acid or hydrochloric acid until all scale is removed, and then rinsed in clean water. Should there still be any little black spots showing on the metal, they must be removed by further pickling, or by scrubbing them with a hard brush and a little fine sand until the iron presents a clean grey uniform surface. The articles are then immersed in chloride of zinc, and on removal from this are dusted over with sal-ammoniac. They are then ready for immersion in the molten tin. If the articles are required to be highly polished, the surplus tin should not be wiped off, but should drain off alone. A brilliant polish is then given by working over the tinned surface with a rag mop attached to a polishing lathe, the mop being dusted over with polishing lime.

Soldering without Separate Flux.—Solder that can be used without a special flux contains the flux—resin—enclosed inside it. This can be melted with a match or red-hot poker. It is used sometimes by electric workers for small joints in wires, and is called solderine. It consists of a very soft solder tube filled with resin.

Particulars of Bismuth.—Bismuth (Bi), specific gravity 9·9, melting point 260° C., is a reddish-white metal with a bright lustre. It is very brittle and crystalline, volatilises at a high temperature, and, burning, forms a crystalline scale—flowers of bismuth. The most important use of bismuth is in forming alloys, as its addition to any metal has the effect of considerably lowering the melting point of that metal. Bismuth may be alloyed with antimony, lead, tin, etc. Bismuth solders may be formed of (*a*) Tin, 4 parts; lead, 4 parts; bismuth, 1 part. (*b*) Tin, 3 parts; lead, 3 parts; bismuth, 1 part. (*c*) Tin, 2 parts; lead, 2 parts; bismuth, 1 part. (*d*) Equal parts of tin, lead, and bismuth. (*e*) Tin, 2 parts; lead, 1 part; bismuth, 2 parts. (*f*) Tin, 3 parts; lead, 5 parts; bismuth, 3 parts. Bismuth is found in the metallic state in the form of bismuth-glance (bismuth and sulphur), in combination with oxygen as an ochre, and in the ores of silver, lead, tin, copper, and cobalt. Furnaces for reducing bismuth each contain a number of inclined iron tubes in which the ore is placed. A wood fire is lighted, and the fused bismuth, together with some impurities, flows through apertures at the lower ends of the tubes into clay or iron pots heated by a fire underneath. The sulphur and arsenic contained in it are removed by again fusing the metal, this time accompanied by one-tenth its weight of nitre.

Surgical Operating Table.—The accompanying sketch illustrates the principal details of an operating table as used in hospitals, etc. The table proper is 3 ft. 6 in. long by 1 ft. 8 in. wide, outside measure-



Surgical Operating Table.

ments; sound joints and firmness should be aimed at in preference to ornamentation. The head and foot flaps are hung on strong butt hinges, and are adjustable with brass quadrants locking on iron bolts fixed through the legs. The tops are webbed and firm, stuffed with best horse-hair and covered with good hessian; this is cased in with wadding, and the outer surface is covered with white indiarubber fixed with copper nails. Birch, beech, or sycamore will be suitable woods to use, as the work is left in the white so as to admit of being scrubbed down.

Colouring Brass Blue-black.—To obtain on brass a blue-black shade, follow these instructions. Dissolve copper turnings in nitric acid until the latter is saturated—that is, until it will dissolve no more; immerse the brass articles in this bath, dry clean, and heat moderately over a clear coke fire, free from smoke. Repeat this process till the correct shade is obtained. Another bath that gives a blue-black shade consists of 1 pt. of water, 5 dr. of iron perchloride, and 1 oz. of hyposulphite of soda. Dip the articles in the solution till they are of the desired tint, then swill and dry in clean sawdust.

Hints on Varnishing a Cart.—Assuming the body of a cart to have been varnished in readiness for the finishing coat of varnish, well flat the body down with fine pumice powder and water, on a pad of cloth, to remove any nibs or brush marks, and to make a dull surface to which the varnish will adhere. After flatting all over, and washing as the work proceeds, give a final wash off, using the water tool freely, to remove any dust that may be left in the corners or quirks; dry off with chamois leather, and allow the work to stand for three or four hours to get thoroughly dry. The work should then be moved to the finishing room, which should be dry, light, and well ventilated, but free from draughts, and kept at an even temperature. The body should now be lightly dusted off with a camel-hair brush (a silk handkerchief is sometimes used), the varnish being poured out some time previous to commencing and placed on a shelf in the room. The brushes, which should have been kept in an airtight container, are now taken out and well worked on the edge of a knife or tin to remove all traces of the oil and varnish in which they have been kept. When commencing the body, do underneath the arch or a similar place, so as to work the brush in a bit, before doing the outside panels; these should have a full, even coat all over. Now lay the varnish off and let it alone; varnish is often spoilt by playing with it as it is flowing out. The brushes should never be used for any other purpose, and after they have been worked down to proper form by using them in colour, they should be thoroughly cleaned with turpentine and soap and water, then gradually worked into inferior jobs so as to bring them up for finishing. Good work cannot be done with a new tool—it is too stiff at the tip; the tool should be stiff enough to work the varnish properly, but soft enough to lay off a good surface.

Hanging Towel-rack.—The towel-rack here illustrated is a convenience where there is a scarcity of room, as in a bathroom or scullery. If suspended by the eyelets it projects no more than 1½ in. from the wall; and when towels are required to be suspended or detached the rods can be pulled forward and afterwards replaced close up to the wall. The frame is of 1-in. stuff, and may be tenoned and mortised at the corners. A, B, and C (Fig. 1) are blocks hinged to the frame by screws in their rounded ends as shown in Fig. 2. A shaped block D, 6¾ in. long by 1½ in. thick, is attached to the frame by dowels. The rails are 1 in. in diameter, and 23 in., 25½ in., and 27 in. long respectively, the ends being reduced and let into A, B, and C. The blocks D are 1½ in. thick to

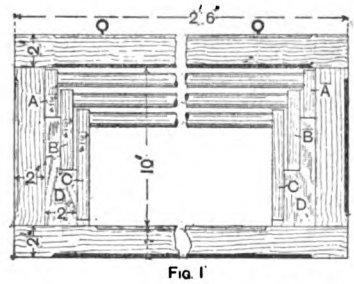


Fig. 1

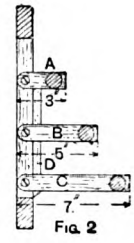


Fig. 2

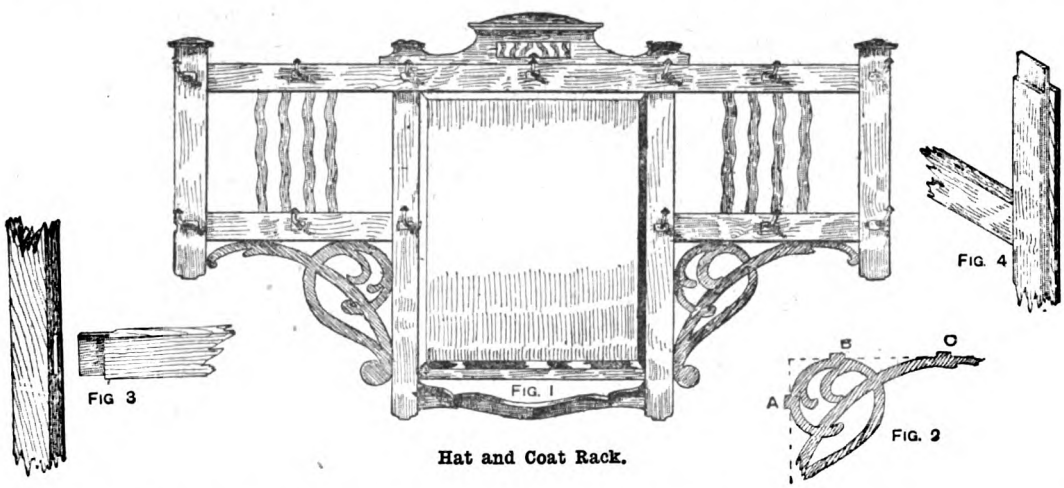
Hanging Towel-rack.

give more support to the rods when let down as shown in Fig. 2; they may be chamfered at the edges to meet the frame. The screws attaching the pieces A, B, and C to the frame should work easily with the heads well sunk, being, however, tight in the outer frame. The whole when complete should be well polished or varnished.

Painting Furniture to Imitate Walnut.—Furniture when grained to imitate choicer furniture woods is rarely built up in oil colours as used by the house painter. The new wood is coated several times with a mixture of glue or patent size mixed with finely crushed or gilder's whiting, tinted to form the ground-work of the finish desired; thus Venetian red is added for mahogany, and yellow ochre for oak or walnut. The mixture is applied hot and should be well worked in. When a solid body has been gained, apply a coat of clear size. The graining can now be done on this surface with oil colours as used by painters and decorators—or they may be mixed in beer as a binder. If a plank walnut is desired, take a quantity of umber ground in beer with a sash tool and cover the entire surface; wipe out the necessary graduations of tone with a sponge and soften or blend all together with a badger softener. To put in a knot, take the sponge between the thumb and finger and give a twist or circular movement and soften off. To imitate burr walnut will require more skill, since a series of irregularly bound knots will be wanted, tied as it were with streaks or veins, and so blended in clusters that there is no appearance of formality. If the furniture in hand has already been painted or polished, the present surface must be cleansed from grease, etc., by washing with warm water in which common washing soda has been dissolved—a teacupful to 1 gal. On a painted surface apply paint as used by house painters. If the furniture has been polished the colour may be altered by mixing suitable pigments, as brown umber or vandyke brown, in 1 part French polish or 3 parts spirits; then finish out with spirit varnish or French polish. Goods built up in size or oil paints should be finished by the application of one or two coats of inside oak varnish.

Making Malay Swords.—A Malay kriss or sword is a short sword with a flat but wavy blade and with the handle turned or bent to fit the hand; it is mostly used for stabbing or thrusting, and, though small, produces a large wound. It is made as follows. A thin slip of hard steel has on each side of it a slip of milder steel. On each side again are placed other pieces, but of iron; sometimes these are of square iron twisted. The whole is then welded together, shaped, ground, and polished. Before the handle is put on, the blade is pickled. Each smith has his own special pickle, but this generally is composed of pineapple, mangosteen, salt, saltpetre, and the urine of animals, pigs' preferred; the whole is mashed together in a tub buried in the ground. In some cases there is a layer of animals' blood on top. The blades are put in with the point stuck in the bottom wood, and the tang is either left out or covered by the blood, the object being to bring out the grain and figure of the metal, which the fruit acids seem to do perfectly. After being immersed a sufficient time, the blades are taken out, cleaned up, dull polished, and the edges sharpened. The handles are then put on, and sheaths are made and ornamented.

Hat and Coat Rack.—The hat and coat rack illustrated by Fig. 1 may be used to utilise a piece of old mirror plate, the original frame of which has become damaged too much for use. If the glass is plain, it will pay to have a ¾-in. bevel put round the edge. The construction is perfectly simple, and involves no operation that is not well within the scope of the merest tyro at woodwork. The only parts that appear to need special explanation are the top and bottom pieces, and the scrolls at the sides. The sediment piece is of thin wood nailed to the top, or top rail; it may be cut to shape with a fret-saw or a pad-saw. The lattice work above the middle peg can also be done in this way. On top of the thin piece of wood is another moulded piece, put flatwise, and on top of that a curved piece, as shown. The scrolls are cut out of thin boards, the grain of the wood running the same way as the main direction of the scroll. Where the scrolls touch the sides of the framework, little projecting pieces A, B, C (Fig. 2) are left on, these fitting into corresponding recesses in the framework. At all the parts of the framework where the end of one piece abuts against the side of another, a simple mortise-and-tenon joint is used for the connection. This is shown in Fig. 3. But at the sides of the pieces that go round the glass a rebate to receive the glass is necessary, and this, of course, will reduce the width of the tenon, as shown by Fig. 4, which is a view of the top end of the right-hand stile seen from behind. The design of the shelf at the bottom of the glass, and also of its supporting bracket, may be varied. The shelf is intended for a brush and hat pad, but no doubt room could be found for a small vase of flowers as well.



Hat and Coat Rack.

Manufacture of Resin Soap.—The following is an account of the manufacture of resin soap slightly modified from one which appeared in the *Soapmaker and Perfumer*. The cheaper kinds of resin soap are used in great quantities for glazing paper and in the textile industries. For paper, the resin is boiled with caustic or carbonated alkali, and the pulp is soaked in the solution. The resin then is precipitated on the paper with acid or a salt of alumina. Better results are given when the soap contains some of its resin in an unsaponified state; from 14 lb. to 16 lb. of carbonate of soda are now used for every 100 lb. of resin, instead of 20 lb. to 25 lb. as was formerly the case. Resin soap should not form a clear solution with water, but must produce a milky emulsion, on account of the free resin. Generally it is difficult to get a soap in which free resin is uniformly distributed in a very finely divided state, as there is great danger of the formation of lumps. The resin must be extremely intimately mixed with the lye, and special appliances are in use for the purpose. The production of a good resin soap is a most awkward job, and there is a need for a simple process for manufacturing a soap rich in resin; the highest percentage of the latter hitherto reached has been about twenty-five. For general purposes other than papermaking resin soap is worthless, except when mixed with tallow or other soap, as is the case with the common yellow soap. The process of making resin soap, described below, depends on the solubility of resin in carbolic acid, which is known also as phenol. The solution then can be partly saponified with alkali, and gives soaps containing 50 per cent. of their resin in an unsaponified form without difficulty or trouble, and without special apparatus. These soaps give perfectly uniform emulsions with water, and the carbonate of soda is still further reduced to 9½ lb. per 100 lb. of resin. The process can be worked in two ways. Either a ready-made soap poor in resin may be reinforced with a solution of resin in phenol, or such a solution may be saponified with alkali. The latter is the better method, but the former can be adopted for utilising soap already on hand. The following are some recipes. (*a*) 200 lb. of powdered resin are dissolved in 40 lb. of crude carbolic acid (boiling at 190° to 200° C.) which has been heated to a temperature of 100° C. A solution of 19 lb. of calcined soda in 4 gal. of water is then stirred in. As soon as frothing ceases, which is soon the case, the soap is finished. Mixed with water at from 60° to 70° C. it gives a uniform and faultless emulsion. The above solution of soda may be replaced by 25 lb. of lye of 43° B., or by 74 lb. of ammonia of ·885 specific gravity. (*b*) A resin soap made with 100 lb. of resin and 15 lb. of carbonate of soda is mixed with a hot solution of 25 lb. of resin in 5 lb. of phenol. Hitherto in the most favourable circumstances the boiling has taken a long time, but when phenol is used, a few minutes at from 80° to 100° C. suffice. When the resin soap is used for paper, the latter takes up the resin, and all but a trace of the carbolic acid goes off in the waste water; even the trace is expelled when the paper passes between the hot calender rolls. Phenol has no effect upon dyes used for paper, so that it can be used for dyed as well as for white paper pulp. Its use entails no risk of fire, as does that of the other solvents of resin such as benzole or petroleum.

White Colour for Brick Wall.—For whitening a brick wall, the following paste should be suitable. Quicklime 1 part, china clay 1 part, silver sand 2 parts; thoroughly incorporate and slake with water until a stiff paste is formed.

Design for Band-stand.—Fig. 1 shows an elevation of a band-stand, and Fig. 2 a half plan of the roof and half sectional plan at the level of the platform. The posts should be of timber about 9 in. square, and the sill pieces 6 in. by 4 in., framed into the lower parts of the posts as indicated. The curb should be 11 in. by 4 in., mitred and framed into the posts; the spaces between the sills and curb should be braced with 4-in. by 3-in. stuff, stop-chamfered and boarded with 1-in.

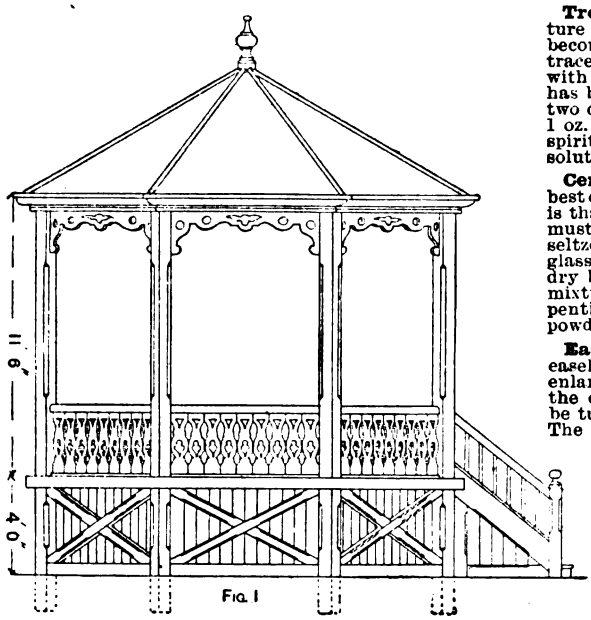


FIG. 1

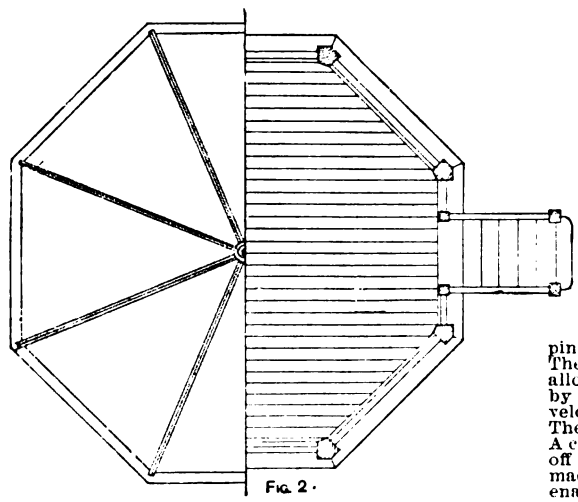


FIG. 2.

Design for Band-stand.

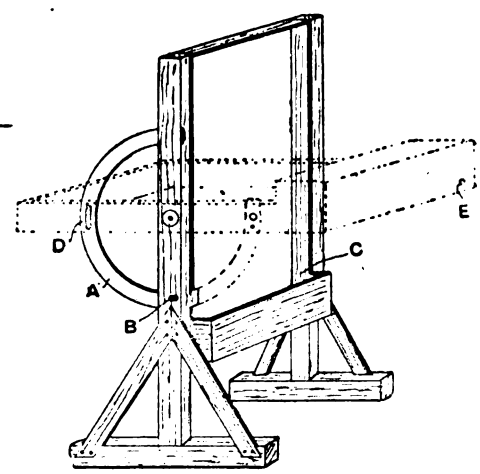
V-jointed, grooved and tongued boarding fixed from the back. The boards of the platform will have to be supported by joists resting on sleeper walls or wooden framing. A plate 6 in. by 5 in. must be framed to the top of the posts, to which ceiling joists are fixed to receive matchboarding nailed on the underside to form a flat ceiling. The roof should be of 4-in. by 2-in. rafters, covered with ½-in. matchboarding; the final covering may be felt, tarred and sanded. Of course, zinc would look much better as a covering.

Preparing Gold Transfer Paper.—Gold can be transferred to paper by a simple process. This is to obtain some clean white tissue paper, or a discarded book that has contained gold leaf, and cut the book down the centre or the tissue paper into pieces about 4 in. square Then, taking a piece of common beeswax in the right hand, stroke firmly downwards or across one of the pieces of paper whilst holding it firmly on a table top with the finger and thumb of the left hand. Now open the gold book, take a piece of waxed paper, place it waxed side downwards on the leaf of gold, press gently with a piece of wadding or the hand, lift the paper, and the gold will be found adhering to it.

Treating Sticky American Leather-cloth.—Furniture coverings of American leather-cloth which have become sticky should be treated in this manner. All traces of grease and dirt must be removed by washing with lukewarm water in which a little washing soda has been placed; then with a soft swab or sponge apply two or more thin, even coats of a solution consisting of 1 oz. of white bleached shellac in ½ pt. of methylated spirit. Or the leather-cloth could be washed with a solution of equal quantities of ammonia and milk.

Cements for Repairing Seltzogene.—Perhaps the best cement for stopping a leak in the neck of a seltzogene is that used for solid perambulator tyres. The cement must be melted and the glass top and metal cap of the seltzogene warmed very carefully before the fire or the glass will crack; both glass and metal must be perfectly dry before applying the cement. Other cements are a mixture of 4 parts of shellac and 1 part of Venice turpentine, and white of egg made to a paste with finely powdered quicklime.

Easel used in Photographic Enlarging.—The easel here illustrated is for use in developing bromide enlargements. By means of the metal quadrant A, the easel, when released by the pin or screw B, may be turned into the position shown by the dotted lines. The bromide paper may then be very conveniently



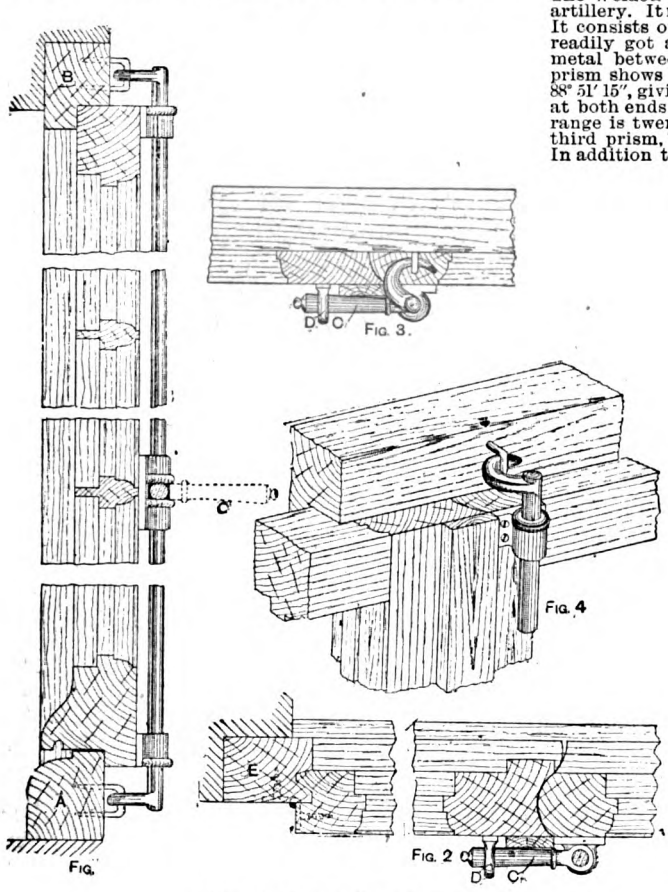
Developing Easel.

pinned down and the easel returned to the vertical. The developer may be poured into the well C and allowed to remain until exposure is completed, when, by again tilting the easel to the horizontal, the developer will flow gently and evenly across the picture. The slot D allows of a slight rock during development. A cork fitted in the hole E allows the developer to be run off as required. The easel, which is a dish, is of course made of wood, and should be painted inside with white enamel; it makes a good ground for focussing, but must be wiped dry before a fresh piece of paper is pinned in place.

Laying Linoleum.—The following is a useful hint as to how linoleum may be laid on a lumpy and uneven wooden floor, which ordinarily would soon wear the linoleum into holes. Common wood sawdust is sprinkled all over the floor to a depth of about 1 in. Over this the linoleum is laid, and in a short time the sawdust will be wrought down into the hollows by the traffic, filling them up so that the bumps are not felt. When the linoleum is lifted some years after it will be found that the high parts are quite free of sawdust and that the linoleum has worn as evenly as if laid on a smooth floor. Cork sawdust, such as that in which grapes are packed, would doubtless be better, but ordinary wood sawdust answers the purpose quite well, and is cheap; it serves much better than felt where the floor is at all uneven.

Cleaning Plush Furniture Covers.—If the dirt is simply loose dust nothing can be done to plush covers beyond well beating and brushing. If the covers are greasy the stains can be removed by lightly sponging the surface with a preparation consisting of ¼ pt. of benzine, ¼ pt. of water, and 4 oz. of liquid ammonia. Keep this well corked, and shake before using. Ox-gall is a capital material for reviving faded and sullied velvets, etc.

French Casement Windows.—The accompanying illustrations show the construction of one form of French casement as used in France. Fig. 1 is a vertical section, A and B being sill and head of frame. Fig. 2 is part horizontal section, in which E is the frame. It shows the method of jointing the locking stiles necessi-



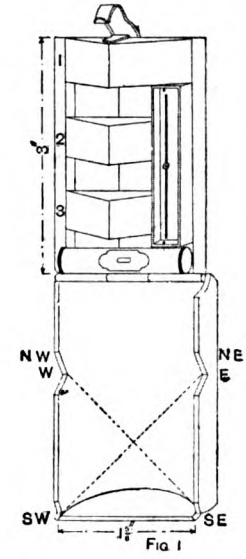
French Casement Windows.

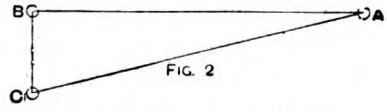
tates both casements being opened together (for part of the way at least). The casements are held tightly to the frame by the rod and hooks, which fasten into the staples fixed to the head and sill. These hooks are so made as to force the casements close to as the handle C is pushed back. The handle is fastened by a catch as indicated at D.

Patent Filler for Carriage-work.—Patent filling-up powder for carriage woodwork is of a bluish tint, somewhat resembling ground-up slate, and is sold ready for mixing. To mix it, add 3 parts of powder to 1 part of tub white lead. This is mixed up very stiff with turpentine and thinned down to working consistency with gold size and varnish, the drainings of the varnish cans being generally kept for this purpose. It is applied with a brush, one coat being put on each day, each coat being laid off as far as possible in the opposite direction to the previous one to prevent ropiness in the surface. Six coats are usually given. The work should be allowed to stand for a week or two to get hard, when it will be ready for rubbing down. To get a flat surface, the work is given a coat of a mixture of turpentine and some colour totally different to the colour of the filling. When rubbing down with pumice-stone and water, the value of this coat will be seen by rubbing a bit and then washing off, when the surface will appear pitted with small holes. These must be gradually worked out until not one remains.

Copying Fluid for Prints.—A very good copying fluid for printed matter is made by dissolving 1½ oz. of soap in 1 pt. of water, and adding about 1 oz. of turpentine; the mixture should be shaken before being used. Very good impressions are obtained if a press is employed.

The Weldon Prism Range Finder for Artillery.—The Weldon Prism range finder (Fig. 1) is employed for artillery. It measures 3 in. by 1½ in., and weighs about 3 oz. It consists of three prisms, so arranged that all can be readily got at to clean, and there is no intervening metal between the reflection and direct vision. One prism shows 90°, and reflects a right angle: another is 88° 51′ 15″, giving a base of 1 in 50; or if this prism is used at both ends either by one observer or by two, then the range is twenty-five times the length of the base. The third prism, 74° 53′ 15″, gives one base to four of range. In addition to the prisms, a trough compass is fitted to





Range Finders for Artillery.

show N and S, and by means of notches in the dome-shaped cover a lead pencil or any straight piece of wood or metal will at once indicate the points N.W. and S.E. and N.E. and S.W., as well as E. and W., most clearly. A level is placed so that any object can be levelled, and will be found handy for other purposes besides setting the instrument so that the right-angle 90° prism can be used as a dipleidoscope for observing the transit of the sun over the meridian by day, or of the stars by night, so as to correct a timekeeper, also for determining latitude. The metal mounting is strong, and the whole is fitted into a solid leather case to go on the waist belt. The problem of range finding may be simply described thus. The distance of any point A from B (see Fig. 2) is determined by means of a short base B C and the measurement of one of the angles of the right-angled triangle A B C. In the fixed type of instrument the angle A C B is a constant, and the length of the base B C varies in direct proportion to the distance of the object A from B. In the Weldon range finder, this is one-twenty-fifth or one-fiftieth, so that every yard of base is equivalent to 25 yd. or 50 yd. of range A B.

Illuminating Addresses.—Next to prepared vellum, and infinitely superior to Bristol board for illuminated addresses, is, in the opinion of many, smooth London board, its cost being its only drawback. Bristol board is simply cardboard faced with a very fine highly glazed cartridge paper; whereas London board is composed of Whatman's hand-made paper throughout. An erasure on Bristol board is difficult to make, as, once the fine skin is broken, a coarse, hairy substance is encountered, but the London board may be scratched half through its thickness, and the surface can still be doctored so as hardly to show. All the gold should be laid on at the beginning, before any colour is applied; also always burnish at once the parts to be so treated. Perhaps it is a matter of taste, but shell gold or its slightly cheaper form, saucer gold, is much to be preferred to cake gold or gold paper. Gold leaf is, in skilful hands, an excellent material, but its application is attended with considerable difficulty, while shell gold is almost as easily applied as colour. The cheaper forms in which "gold" is sold are nearly all impure, and liable in time to turn black. Shell gold is the pure article ground to an impalpable powder in weak gum water; if properly used, it is not wasteful, and produces the best effect. Always use guards or flaps of cartridge paper which can be folded so as to expose only the portion on which work is being performed. A good way to cut these is as shown in Figs. 1 and 2, Fig. 1 being the upper flap, and Fig. 2 the under flap. $A^1 B^1$ should be greater than A B. The dotted line shows the limit to which each flap can be folded. In addition, always keep several pieces of clean white blotting paper on which to rest the hand when working. Work with as small a quantity of body colour as possible. Indeed, rarely use any unless one colour is to cross precisely as paper. As, however, it is of a gluey nature, the whole sheet more or less may adhere to the drawing board on which it is strained. To obviate this a "strainer" (*i.e.* a hollow frame similar to those used with canvases for oil painting) may be used, and on this the vellum is stretched; see B (Fig. 3). The frame must be made with the greatest accuracy as regards squareness, and is gauged to a thickness, the outer arrises being very slightly rounded, and the inner left perfectly sharp. The skin chosen must be large enough to pass round the "strainer" and be tacked along its back. As it is not possible to work on the vellum where unsupported between the sides of the strainer, a piece of clean American yellow pine must be got out to fill the interior, thus rendering the strainer practically a solid board; see C (Fig. 3). In order to have a board on which to work and pin down the guards mentioned above, a hollow frame A (Fig. 3) may be fitted round the strainer, just giving clearance enough to pass the vellum, being itself made accurately square. Then two battens D of hard wood across the back, with six screws in each, may be made to hold the whole and prevent warping. Fig 3 gives the back view of the boards. Important work should be traced first (of course, omitting the minute detail), and transferred from the tracing. It is always advisable to begin at one corner, and carefully to lift both copy and transfer paper so as to mark the effect at the beginning. This enables the illuminator to gauge the effect of his strokes, and, if necessary, to modify them. The beginner is advised to try to gain his best effects by dignified rather than by tawdry ornament. Exceptionally ornate work is not always the best; the general effect must be studied, and the balance of colour and ornament, as well as the harmonies of all parts.

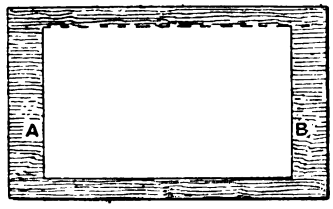


FIG. 1

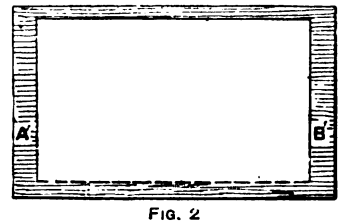


FIG. 2

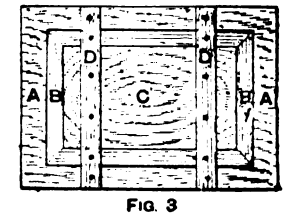


FIG. 3

Illuminating Addresses.

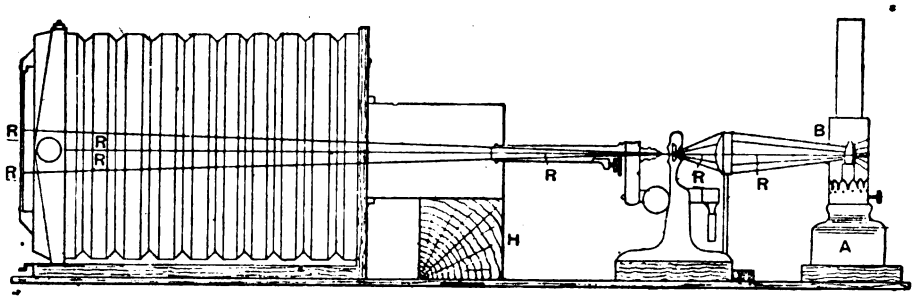
another. Body colour tends to give a clouded appearance. Transfer paper is best prepared as follows. Pin down a piece of thin tracing paper—it should be strong but not of vegetable parchment—cutting it rather larger than the illumination, and using, say, ten pins so that it will resist rough usage. Take a little powdered blacklead (Nixey's cake stove polish is good), and rub it on firmly and evenly with the finger or with a piece of dry washleather, working the lead all ways until the surface is evenly covered. Then, with a piece of dry washleather or folded blotting paper, rub off as much of the lead as possible, changing the leather or blotting paper as often as it becomes well soiled. After a few minutes it will be found that very little lead can be rubbed off, and the paper is then ready for use, and will give a clear line transfer when a hard point is drawn across its back, but will not soil the drawing where the hand rests on it. A piece of paper so prepared will last for years if occasionally touched up with blacklead. In the case of addresses on prepared vellum, it is always best to "strain" the material; and if no previous experience has been had, it will be well first to experiment with a piece or two of paper. Prepare some strong glue or quickly setting paste. Determine which side of the paper is to be drawn upon, and lay it on a board with that side down. Take clean water and a clean sponge, and damp it well on the uppermost side (that is, its side), keeping the paper very wet until it buckles well. Then quickly sponge off superfluous water, and lay the paper face upwards on the drawing board, bringing its edges square. With a T square draw a pencil line say 1½ in. from one edge; then advance the square to, say, ¾ in. from the edge, and fold up the paper along the square. The glue is then applied to the underside of the folded-up portion, and the glued edge is quickly pressed down with a flat piece of wood, care being taken to squeeze out superfluous glue, and not to let it work back under the drawing. The other sides are quickly treated in the same way, and the paper is allowed to dry slowly. Ruling the line shows to what limits it is safe to cut; the line farther from the edge than the glue gives a margin of safety to the cut line. Vellum is treated

Working Brass for Scrolls, etc.—Brass cannot be hammered out the same as wrought iron. The end of a scroll may be slightly widened by hammering on a bright anvil; if more than this is desired, the pieces must be brazed on. Hollow leaves may be made by having the shapes carved out in wood blocks, which serve as patterns for castings in iron or lead and tin. These form the pattern into which the brass or copper is driven with punches. If a quantity of the same pattern is required a fly may be used with a lead and tin matrix.

Preventing Smell of Soot from Chimneys in Summer.—It is a very common trouble in summer for chimneys to smell very strongly of soot even when they have been swept. In summer time the current of air or draught in many chimneys is reversed, as the house interior is warmer than the insides of the chimneys. The house may be said to have become the chimney, and the chimneys act as so many inlet air ducts to keep up the draught in the house. Chimneys that give no trouble whatever in winter will act in this way in summer. The only remedy is to stop up the chimneys when fires are done with, and rely on the windows for ventilation during the summer time. The register flap provided with most grates is for this purpose. An old country method of preventing the smell is to put a sack of straw up the chimney.

Extracting Juices from Plants.—The proper way of extracting juice from plants is to cut the plants fine and press them in a tincture press; but very often an infusion is made by boiling the plants with water and straining the solution; the infusion may be used as it is, or concentrated to an extract upon a steam bath. The part of the plant to be employed depends on what plant is used. In some plants like aconite, etc., the active principle is obtained from the root; in ipecacuanha, etc., it is obtained from the twigs; in coca, from the leaves; in the nux vomica, from the seeds; in the poppy, from the seed capsules; camomile, from the flowers or catkins. Few flowers are used medicinally Usually, the plant is better before flowering.

Photo-micrography.—Photo-micrography would lose much of its mystery and be better understood if it were regarded as making an ordinary enlarged negative, for the optical principles involved are very similar. The same precautions must be taken as would be necessary if enlarging with an uncorrected lens. That is to say, the micro objective not being corrected for photography, the rays that most strongly affect the sensitive silver salts (namely, blue and violet) will come to a focus nearer the lens than will those rays chiefly used in forming the usual image. This defect may be overcome by using monochromatic light, thus excluding all rays except those of one colour, or by racking in the screen after focussing to the focus of the chemical rays. A monochromatic light is difficult to obtain, and means an increased exposure, whilst focussing the chemical rays is to some extent guess work, and can never result in the acme of definition, for at the focus of the chemical rays the visual rays will be spread out in a halo around each point of light, as explained in Series I., p. 327. On the whole, the latter plan is more suitable for a beginner, for if one degree of magnification is adhered to, the distance between chemical and visual foci will be constant, and may, therefore, be found by experiment once for all, and the ground glass fixed in the frame at exactly the correct distance behind the register of the plate, so that when the plate is focussed the violet rays are in focus for exposure. The condenser may be any lens capable of collecting a large quantity of the rays and condensing them to a fine focus. This is, of course, better effected if the condenser is an achromatic one. The microscope may be used either with or without the eyepiece. The latter method is preferable; but if great magnification is required, together with short extension of the camera, then the eyepiece must be left in so that it may widen out the rays in the same manner as does a telephoto lens; this is explained in Series I., p. 336. In fact, a microscope may be considered as a telescope used at close quarters. The definition so obtained is, however, generally much inferior with a medium quality instrument, and the difficulties arising through chromatic aberration are increased; therefore begin without the eyepiece. Any ordinary camera may be used, but a heavy rigid pattern is to be preferred. The longer extension the camera has the better, so that it is generally more convenient to use a large camera with carriers for small plates. Even then the extension may possibly be insufficient, but this is easily overcome by making a box front to fit neatly in the front grooves of the camera. Such a box may be made of stout cardboard glued together, with an opening in the end to fit the microscope tube. The box should be covered inside and out with dead-black paper, such as is used for wrapping photographic papers. The sketch shows such an arrangement as that described by which magnified images of say 50 diameters may be secured with a 1-in. objective without using the eyepiece. The light A consists of a centre draught paraffin lamp having around it a tin shield which may be easily made by cutting a square opening in the side of a canister, and turning back the sides to hold a glass screen if required at B. The bottom of the canister is then removed so that it may be slipped over the lamp to shield off the rays not required, the course of the other rays R being as shown. All the parts must be fixed firmly and rigidly, for although a certain amount of makeshift may be allowed, satisfactory results are impossible should there be the least vibration. For this purpose a long board should be made, to which the various parts may be bolted firmly. The board may be hinged at H and bolted before use. The greatest care must be taken in every way to secure the nearest possible perfect definition. It will be noted at once, however, that although the smallest movement of the microscope screw will seriously affect definition, a considerable adjustment of the ground glass is allowable. For roughly setting the distances at the outset, the old rule may be once more applied. Divide the diameter of the proposed image by the diameter of the subject (or portion of the subject) to be included (this gives the ratio or number of diameters), then the distance between objective and ground glass will equal the ratio plus 1 multiplied by the focus, and the distance between objective and object will equal the product of the above divided by the ratio. Or if D = greater conjugate and d = lesser conjugate, then $D = (r + 1) \times f$, and $d = D \div r$. Ordinary plates, developer, and printing may be employed, but bear in mind that in photo-micrography detail is everything.



Apparatus for Photo-micrography.

Cleaning Photographic Dishes.—For eliminating traces of hypo from a photographer's trays and dishes, it is best to use water; but the following solutions are sometimes useful. Soak the dish in a 5 per cent. solution of peroxide of hydrogen (twenty volumes) and well wash. Anthion, or a saturated solution of alum, may also be used, the object being to change the hypo into some less injurious compound, which must also be removed by washing. Unfortunately the compounds so formed are usually less soluble than hypo, so that the benefit is questionable. It is a good plan to keep on hand the following solution, to be used for cleaning dishes; it may be used again and again. Potassium bichromate 1 part, sulphuric acid 1 part, water 20 parts.

Prismatic Colours on Weathered Copper.—As soon as copper is exposed to the weather it begins to oxidise superficially, and the thin film of oxide acts like all thin films, and separates the rays of light into their various colours; that is, a more or less perfect spectrum is obtained. As the film of oxide becomes thicker some of the rays are absorbed, while others are reflected, giving the sensations of yellow, red, blue, or green, which are often banded owing to the different thickness of the oxide in different parts. The colours produced in this way are very brilliant, as they are the pure colours of the spectrum. The dulling of the colours as time goes on is due to the formation of a thicker film of oxides, of which there are two, namely, red cuprous oxide (Cu_2O) and black cupric oxide (CuO). The formation of verdigris is usually due to acidity in the atmosphere; verdigris can be induced by sponging the copper with vinegar.

Preparing Concrete.—Concrete is composed of either ballast, broken bricks, stone chippings, slag, etc., and sand, cemented together with lime or cement mixed with water. The materials are measured out in boxes or barrows, and thoroughly mixed together in a dry state; water is then added from a hose to which a sprinkler is attached, and the material again turned over several times until thoroughly incorporated, when it is ready for use. A platform of boards, called a banker, should be laid down on the ground for the preparation of the concrete. There are several machines worked by steam power for mixing concrete; these are much used on large works, such as docks, breakwaters, public buildings, etc., where great quantities of concrete have to be prepared. The proportions in concrete vary, but a general one is as follows. (1) Ballast, broken brick, etc., 6 parts; coarse sand to fill the interstices, 1 part; and Portland cement, 1 part. Also, ballast, broken brick, etc., 3 parts; coarse sand to fill interstices, 1 part; and ground lime (stone), 1 part. (For other proportions, see Series I., pp. 88 and 158.)

Ferro-prussiate Paper for Photographic Prints.—Below are given some particulars as to the methods of making and using ferro-prussiate paper. Prepare two solutions: (*a*) Citrate of iron and ammonia 1 oz., water 4 oz.; (*b*) Potassium ferricyanide 1 oz., water 4 oz. Coat any tolerably pure paper of fine texture with solution (*a*), using for the purpose either a broad flat brush or a tuft of wool, the paper being pinned on a clean board. The wool may be fixed in the end of a piece of glass tubing and held so by passing round the wool a wire and bringing the two ends out through the opposite end of the tube. The brush should be drawn from side to side, and there should be a slight overlapping at the edges. Keep the coating as even as possible, although considerable unevenness seems to have no bad effect. The paper prints very slowly. When a fairly dark brown image appears, (*b*) solution is applied by flowing it over the print. The result will be a picture in Prussian blue. The print is then passed through a weak solution of citric acid, washed for a few minutes in water, and hung up to dry. This is the cheapest of photographic printing processes, costing very little beyond the plain paper, but is, of course, very unsuitable for general work. The ferro-prussiate process is chiefly used for copying plans and drawings or for moonlight scenes.

Wedging Heads on Hammer Shafts.—There are many ways of wedging the heads of hammers in place, all more or less satisfactory, but for wooden wedges one of the best methods is to bore with a bradawl two sloping holes (Fig. 1), as at A and B (Fig. 2), through the outer end of the handle and the wedge, after the latter has been driven tightly into the handle. Then drive into each a strong wire nail, and file it off close. Even if the wooden handle or the wedge itself shrinks somewhat, it is next to impossible for the latter

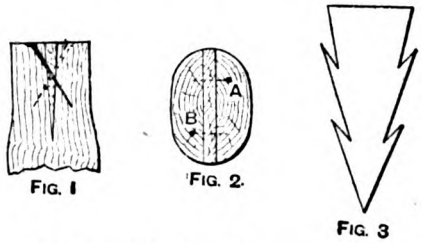


FIG. 1. FIG. 2. FIG. 3

Wedging Heads on Hammer Shafts.

to work loose and fall out, and so cause the hammer head or other similar tool to fly off while being used. Another method is to use an iron wedge; while this is red hot, make two or more cuts on each side (see Fig. 3) with a sharp cold chisel, so as to raise the surface something like a very coarse single-cut file or a fish hook; then drive in the wedge as tightly as possible.

Renovating Mackintosh.—The appearance of a faded black mackintosh can be improved in the following way. Prepare a solution of ferrous sulphate (copperas) by dissolving 2 oz. in 1 pt. of water; prepare also another solution by boiling 4 oz. of logwood chips in 1 pt. of water, strain and add a little carbonate of ammonia. Now lay the mackintosh on a table and sponge it well all over with the ferrous sulphate, and afterwards with the logwood solution. It may improve the colour to go over it more than once with the latter.

Painting Bromide Enlargements in Oil.—For the painting of bromide enlargements in oil a knowledge of drawing and oil painting is essential. Workers often prefer to paint without a photographic basis, merely using the enlargement to produce quickly a rough tracing on the canvas and to correct the drawing. By using only transparent colours the danger of destroying the likeness may to an extent be avoided, but the use of opaque pigments is essential to the production of a well-executed painting, full of force and brilliancy, and correct in modelling. One having but little knowledge of drawing and anatomy should keep the colours well thinned with megilp, thus preserving the transparency and conveying to the picture the effect of tinting with water colour. General hints only can be given, as the actual painting is too wide a subject to be treated here. Study the face closely and experiment with colours to determine the tints to be formed. The photograph should be clear and sharp, but with gradations as perfect as possible. The eyes and nose should be well defined. The enlargement needs no preparation beyond a thin coating of size. The following is a full list of the materials required. The colours include flake white, light red, vermilion, vandyke brown, rose madder, cobalt, crimson lake, emerald green, raw sienna, burnt sienna, sepia, Indian yellow, carmine, ultramarine, gamboge, indigo, yellow ochre, ivory black, Indian red, raw umber, burnt umber, and terra-serta; megilp, poppy oil, mastic varnish, brushes, mahl stick, easel, palette, knife and turps, are also wanted. In painting the hair see that it is kept soft and not too strongly defined, especially where it meets the forehead, the hair here appearing transparent in nature; it should be softened into the flesh tint with a delicate shade. Keep the shadows—particularly of the flesh tints—warm, as the grey colour of the bromide is apt to impart a bluish corpse-like appearance. The colours for the background should be carefully chosen of a complementary nature to give force to the figure.

Re-modelling a Round Oak Table.—At very little cost an old-fashioned round oak snap table, with the usual turned centre pillar and three curved legs, may be converted into a sitting-room table. After having planed, scraped, and glass-papered the top quite smooth, cut it to the shape of an octagon, keeping the corners to the full diameter of the circle, and then plane the edges true and square, and chamfer off the top arris ¼ in. each way. Next make, or procure from a local joiner, about 16 ft. of oak scotia moulding made from ½-in. stuff, and mitre and fix it all round the edges as shown at Fig. 1. Use a small bradawl for boring the holes, and fix with small wrought-iron sprigs. Then on the underside of the table top fix with screws pieces of 1½-in. by 1-in. white wood, about ⅜ in. back from the joint made by the moulding, and to these fix pieces of oak ½ in. thick

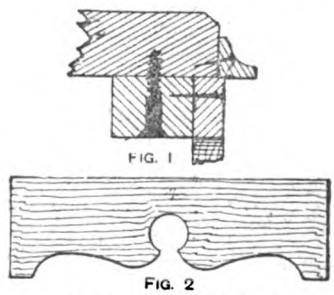


FIG. 1

FIG. 2

Re-modelling a Round Oak Table.

by 2½ in. wide, cut to the shape shown at Fig. 2 and mitred at the corners. Next get three turned oak pillars, 1½ in. thick and a little longer than the distance between the curved leg and the block on which the table top hinges. These should be left square for about 2 in. at the top and 1½ in. at the bottom. The pattern of the turning is best decided by the worker himself, but the design should not make the pillars look spindly. Cut tenons on the upper ends of the pillars about ½ in. long, and for these make holes in the block immediately over the legs, and about 1½ in. from the centre pillar. Now carefully fit the lower ends on to the legs and fix the whole in position with fine sprigs. By the judicious use of a tenon saw and chisel, the feet, which are usually plain, can be made to represent a claw, thus adding greatly to the appearance. Stain the new wood to match the old, and stop up the nail holes, etc., and then polish or varnish according to ability.

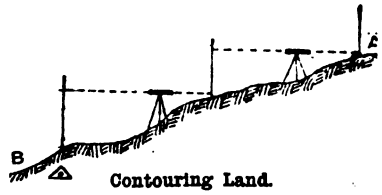
Flanging a Steel Disc.—Below is explained how to turn up a ¾-in. flange on an 8-in. circular steel plate ⅛ in. thick. After annealing the disc with a stretching hammer, turn up a puckered edge by means of a series of radial blows delivered on the metal while resting upon the nose of a mandrel. Then, still holding the metal with the base of the puckered edge resting close up on the nose of the mandrel, commence working round the edge from the base with a series of blows from the hammer, delivered across the puckers or concentrically. Continue working round the edge from the base, and then gradually upwards to the top of the flange until the puckers are gradually worked out and the flange or edge is set up square.

Invisibility of Steam.—Steam at 212° F., that is the temperature of boiling water, is a true gas and is quite invisible; the steam seen issuing from a kettle spout, or from any vessel in which water is boiling, is somewhat cooled by coming in contact with the air, and is therefore not entirely steam; it contains innumerable minute particles of condensed water which render it visible.

Contouring Land.—The following are simple instructions on shifting the level in contouring. The vertical interval having been decided, say 20 ft., a set of pickets marking initial points are fixed at 20 ft. differences of level along the initial or section line. The initial line is generally taken along a watershed. Suppose A B in the illustration to represent the initial line on which the contour or initial points are to be fixed. An assistant holds the levelling staff vertically at A with its face towards B. The surveyor places the spirit level so far down the slope that the telescope when levelled may intersect the staff near the ground. The back reading is then taken, and suppose it is 1·5 ft. this is entered in a table to avoid error, thus:—

Back reading.	*Forward reading.*	*Difference.*	*Remarks.*
1·5	13	11·5	
2·3	10·8	8·5	
		20	Initial point.

The levelling staff is now taken down the slope along the initial line as far as possible, but not below the plane of the telescope, and is held vertically with its face towards A. The surveyor, without changing the position of the spirit level, turns the telescope round so as to read the staff. Suppose the forward reading is 13 ft., this is entered in the table: a point is thus found 13 ft. − 1·5 ft. = 11·5 ft. below A. Without changing the position of the levelling staff it is turned round with its face towards B. The surveyor takes the spirit level lower down the slope on the initial line so as to read the staff near the ground. Suppose this back reading is 2·3 ft., it is entered in the

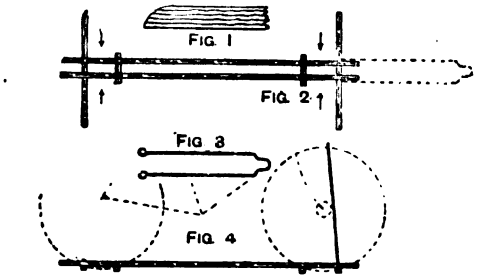


Contouring Land.

table. A point representing a further fall of 8·5 ft. must now be found so that the first contour point, 20 ft. below A, may be fixed. The telescope is now turned round and the assistant holds the staff vertically lower down the slope, and if necessary moves it backwards or forwards along the initial line till the horizontal hair in the telescope gives a reading of 10·8 ft., which is entered in the table. This gives the first contour point 20 ft. vertically below A. The other contour points are found in a similar manner. The initial or contour points being fixed at vertical intervals of 20 ft., the first contour is proceeded with as follows. A position is found for the spirit level, from which a view throughout can be obtained of the ground on which the contour will lie, and this position must also be such that the telescope when levelled may intersect the levelling staff held at an initial point. The telescope being levelled and directed on the staff, the surveyor signals to the assistant to slide the vane along the staff until it coincides with the intersection of the cross hairs, and it is then firmly fixed in this position. The staff bearer now moves along the contour at fixed pickets to define its shape (at salient and re-entering bends), and when he judges he is near the proper level he holds the staff perpendicularly with its face to the surveyor with the spirit level, who will, if necessary, signal to him to move up or down till the vane again coincides with the cross hairs: the foot of the staff is now on the same level as the initial point, and its position will be marked with a picket. If the contour passes round a hill out of sight of the telescope the spirit level must be moved to a fresh position. The staff is held at the last position fixed, the spirit level is carried to the new position and set up, and another surveyor directs the telescope on the staff and signals to the assistant to move the vane and fix it again on the staff at the intersection of the cross hairs of the telescope. The picketing of the contours is then proceeded with as before.

Manufacturing Margarine.—To prepare margarine from beef fat extensive plant is wanted. The fat is first melted, and is then run into large tanks in the granulating room; this room is kept at a temperature of about 80° F. After standing for some time the fat separates into two portions—a granular solid portion or stearin, and a fluid oily portion or olein. The mass is next run into filter presses, in which the olein is pressed out, and the stearin remains on the filter bags. On cooling, the olein, or oleo as it is termed, solidifies to a buttery-like mass having a slight beefy odour. The oleo is melted down and mixed with a certain proportion of refined cotton-seed oil, the amount added varying with the season, and being more in winter than in summer. The mixture is then run into churns with some milk which has previously been soured with rennet or a little acid. The churns are steam-jacketed, and are kept at such a temperature that the fat is just melted and the casein from the milk is taken up by it. After churning, the vessels are emptied into a large tank containing water in which ice is floating; the margarine at once solidifies, is fished out, and piled up on large lorries, where it is allowed to drain. Colouring matter and salt are then added, and the margarine is kneaded and rolled until it assumes the texture of butter.

Simple Cycle-stand.—To make a simple cycle-stand as here illustrated, take a piece of pitch pine, ash, oak, or other hard wood, 5 ft. long, 3 in. wide, and 1 in. thick, and having lined it with a straightedge, saw it into three strips, each 1 in. square. Plane these to ¾ in., and saw one of the strips into four pieces, two 2 ft. long, and the remaining pieces 6 in. long. With a spokeshave round down the corners as in Fig. 1, and also smooth the pieces with coarse glasspaper, so that they will not injure the tyres. Now measure the distance between the centre of the two hubs of the bicycle, which may be anything between 40 in. and 50 in. Assuming 44 in. as an example, take the two long pieces, and having marked the centre of each, mark



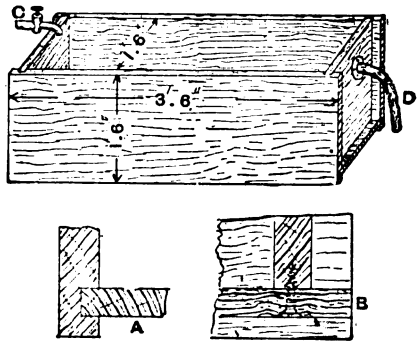
Simple Cycle-stand.

off 1 ft. 10 in. from it each way. Now mark off 4 in. each side of these marks, and on the under side screw the four remaining pieces across with 1½ in. iron screws, as shown by Fig. 2, the screws being let in from underneath. The two 5-ft. strips will be 2½ in. apart. Then take a ¼-in. iron rod, and, having measured the front wheel, bend the rod to the shape shown by Fig. 3. It will be a little wider at the top than the tyre, and about ¾ in. longer than the wheel. The eyes, if heated, can be easily bent with a pair of pliers. Screw this support to the long strips just above one of the two cross strips, so that it moves easily. Varnish the woodwork, and enamel the iron support. To use the stand, run the cycle wheels into the groove, so that they rest between the cross strips, and put the iron support over the front wheel, as shown by Fig. 4.

Composition for Covering Steam Pipes. — The compositions used in England for covering steam pipes and boilers are all the subjects of patents, but it is not a difficult matter to devise something that will answer the purpose. Air confined round the source of heat is a very good non-conductor of heat, and any material that is full of air cells is a very good covering for steam pipes. Hair felt is an example of a good covering, because it is full of air cells, and if the felt is afterwards well wrapped up or plastered over with an impermeable outer skin, the result is still better. Hair felt, of course, is not a composition, but the example serves to show the kind of covering that is wanted. The materials that figure in compositions are cork in coarse powder, chopped hair, hay, cocoanut fibre, sawdust, and other materials of a like nature that, when applied to the pipe, will retain a large quantity of imprisoned air. Fireclay, as well as ordinary clay, is used as the cementing material; a little plaster-of-Paris or Keene's cement is helpful, but Portland cement is not good. Only cheap and common substances need be used, and a thickness of 1 in. ought to be sufficient. It is advisable, before applying the bulk of the mixture, to rub some of it on the pipe and let it dry, so as to form a key. The composition should, as a rule, be applied when the pipe is hot.

Working Celluloid.—Celluloid is made from the variety of nitro-celluloid known as collodion cotton, by incorporating with it sufficient camphorated spirit or acetone to render it plastic; if the material has to be pliable 5 or 10 per cent. of castor oil is also added. The colours employed are either mineral or opaque colours, or aniline dyes for transparent tints. The former are incorporated with the above mass; the latter are dissolved in the spirit. Mineral colours are lampblack, red lead, yellow ochre, ultramarine, Prussian blue, Brunswick green, chrome yellow, umber, etc. The aniline dyes are eosin, methylene blue, aniline orange, malachite green, methyl violet, magenta, nigrosine, etc. The latter have great staining power, and must be used sparingly. The celluloid dough is moulded preferably in brass or iron moulds, or if necessary in wood or plaster; hollow pieces are made in halves, with overlapping edges, and are cemented together with a little of the celluloid thinned with spirit. After moulding they are simply left in the open air to allow the spirit to evaporate. The transparent celluloid articles may be made from a more fluid material which has been filtered under pressure and afterwards concentrated, but the castor oil renders the material more transparent. The opaque white material is made by incorporating pure chalk or zinc oxide with the dough. Nitrate of cellulose is being replaced by the new celluloid, acetate of cellulose (see Series I., p. 259).

Box for Live Eels.—A box for keeping about 25 lb. of eels alive in running water can be made to the dimensions shown in the sketch. Procure some clean, sound 1¼-in. pine; groove the ends for about ¼ in. into the

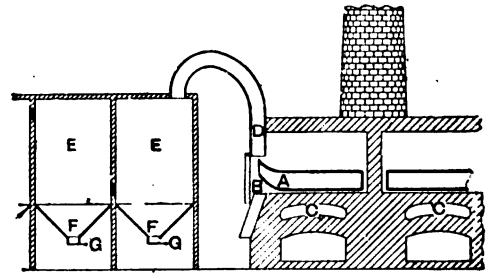


Box for Live Eels.

sides, and groove the bottom edges of the sides for the bottom as at A. The method of securing the bottom to the ends is shown at B. The box should be put together with 1½-in. No. 12 or No. 14 brass screws, and all the joints should be coated with thick white lead. The water may run in at C with a fall of 5 in. or 6 in., and out at the overflow at D, a piece of perforated zinc being placed over the outlet to prevent the eels getting into the pipe. If a running stream is available, a large bacon box fitted with a lid and fine wire net or perforated zinc at each end may be secured with a rope and sunk with a few bricks into the water.

Making and Applying Typewriter Ink.—An ink for typewriter ribbons that has given satisfaction is made thus. Place ½ oz. of aniline dye (violet or green for preference) in a bottle, and add 1½ oz. of glycerine and double this quantity of hot water; place the mixture in an oven and let it get thoroughly warm (not boiling) and then add 3 oz. of French polish (shellac and methylated spirit); put it in the oven again for a few minutes, then vigorously shake for a few minutes, and it is ready for use. The bottle should not be entirely filled. A method by which the ink may be applied to a few ribbons is as follows. Procure a large stiff piece of cardboard (such as the side of a bonnet- or hat-box) and on it fasten one end of a ribbon with a pin; then pass it over the cardboard, backwards and forwards, and pin at the other end, or if there is more than one ribbon to be done, pin them end to end and fasten the last end into the cardboard. Now into the dish or tin pour some ink, and apply it with a tooth brush, rubbing it well in; let it stand over night, and then give another coat, as a large quantity of the ink quickly dries into the cardboard. A plan which prevents much waste of ink is to procure, instead of cardboard, tin-plate and have the edges turned and soldered over, so that they cannot cut the ribbons; punch a few holes in the tin, and attach the ribbons by passing a small tack through the same and through the tin. A ribbon can be re-inked with one coat in this manner, as the tin will not soak up the ink. The inked ribbon should be smoothed, or it will produce smudged writing. Procure an old dull knife, and if it is at all sharp, either rub down the edge or use the back blunt edge. Procure also another piece of cardboard, and on it place a length of the ribbon, and with the knife scrape on both sides to remove smudges. After a little practice this can be done without injury to the ribbon; then wind the ribbon on the spool, and it is ready for use. Another method of inking ribbons is to make a tin or zinc dish with a roller mounted in the centre; fill this with liquid ink, pass the ribbon under the roller, then have the felt-covered roller frame screwed down to the table, and either pull or wind the ribbon through (see also Series I., pp. 74, 97, and 307).

Preparing Zinc White or Chinese White.—Zinc white or Chinese white is oxide of zinc, the exact composition being zinc 80·25 per cent., oxygen 19·75 per cent. The methods of preparing zinc white are many. The principal one is to sublime metallic zinc in fireclay retorts and allow the vapour to burn in air, the resultant fumes subsequently being condensed. The retorts are set in series, back to back, in a reverberatory furnace (see illustration), the mouths of the retorts A opening into an air-chamber B at the front of the furnace, which is supplied through the flues C with air heated to a high temperature by the waste heat of the furnace. A bent pipe D connects the top of the air-chamber with the condensers E, these being rectangular chambers connected in series of four by wire-gauze-covered openings alternately top and bottom; the chambers are prolonged into hopper shapes at the bottom



Furnace for Preparing Zinc White or Chinese White.

F and have slides for opening and closing the apertures G. In preparing the pigment the retorts are made red-hot, and then a bar or two of metallic zinc is placed in each retort. The metal melts and volatilises quickly, the vapour becoming ignited in the air-chamber, where it meets the current of hot air; the fumes then are carried by the tube D into the first condenser, whence they pass into the others. The zinc oxide (the zinc or Chinese white) is condensed on the walls of the chambers and in the hoppers, and from time to time is swept down and delivered through the hoppers into barrels. The pigment in the first chamber is generally of a bad colour, being contaminated with metallic zinc, but the product in the other chambers is pure white.

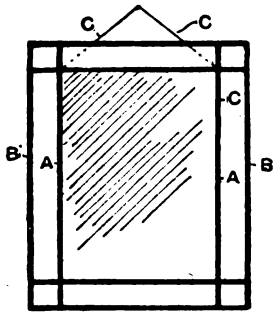
French Polishing Cheap Work.—Cheap goods that are to be handled in large quantities should be brushed over once or twice with glue or patent size, diluted with sufficient water to form a firm jelly when quite cold. Dry pigments may be added, such as yellow ochre to give an imitation pine, brown umber for imitation walnut, and venetian red for mahogany; if the size is sufficiently strong and well brushed over the goods and any surplus wiped off with rag, the result should be a surface on which the application of two coats of spirit varnish laid on with a camel-hair brush will give a very passable finish. If the goods have been turned in a lathe, the size, or combined size and stain, may be used, the articles receiving a smart rubbing of polish and being finished with one coat of a cheap shellac varnish.

Cheap Shellac Varnish.—A cheap grade varnish is made as follows. Common shellac, 6 oz.; gum thus, 4 oz.; resin, 4 oz.; methylated spirit, 1 qt. Dissolve with frequent agitation; strain through muslin. Should it prove too thin or too soft to give a satisfactory result by two applications, add more shellac.

Rendering Linen Light-tight.—Linen may be blackened and rendered light-tight by the application of a coat of Brunswick black thinned with a little turpentine.

Constructing a Pond.—A pond having been excavated has its bottom and sides lined with clay puddle, 12 in. or 18 in. thick, laid in 6-in. layers, and well rammed to prevent leakage. In making a pond by this method, however, a good deal of trouble is often caused by subsequent leakage, which sometimes necessitates the emptying of the pond and doing the whole work over again, because it is difficult to locate the faulty places. A much safer method is to form the bottom and sides of the pond of good cement concrete, 9 in. thick, finished with a ½-in. skin of Portland cement mixed with an equal quantity of clean sharp sand. A still better plan would be to embed in the concrete Callender's sheet bitumen, which is much used for lining service reservoirs.

Uses for Old Negatives.—Waste photographic negatives, glass being so cheap, are practically of no value, though now and again uses may be found for a small number of negatives if the cleaning off of the old films is not too much trouble. The films may be removed by soaking in the hypo bath, or in a saturated solution of washing soda, or more readily in a solution of hydrochloric acid or hydrofluoric acid. A few seconds' immersion in the last named causes the films to float off, leaving the glass clean. The cleaned glasses, if cut down, may be used for lantern-slide cover glasses. Every printing frame should contain a clean sheet of glass, as it serves to protect any working up on the back of the negative as well as minimising the chances of breakage. A broken negative may be preserved, and sometimes satisfactorily printed from, by binding it with strips of gummed paper to a sheet of clean glass of the same size. The glasses also may be used as a substitute for picture frames by enclosing a photograph between two glasses and glueing the glasses together with strips of black tape A round the edges (see illustration). The outer edges may also be bound with black paper at B, and a hook of wire C slipped under where the two tapes cross (see dotted lines) serves to hang it. The glasses of old negatives, however carefully cleaned, cannot be re-coated satisfactorily and used again.



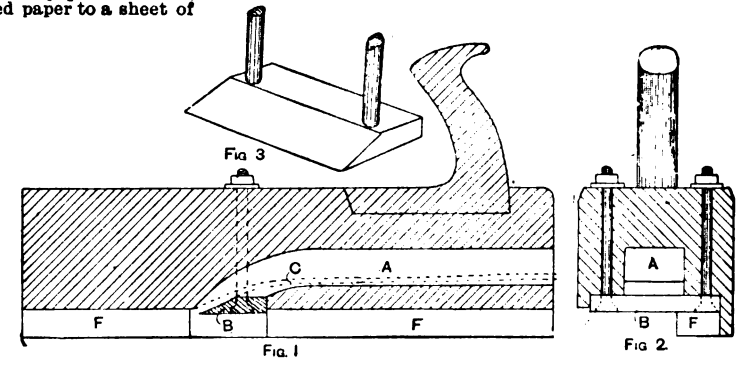
A Use for an Old Negative.

Recovering Tyre Outer Covers.—Here are instructions on re-covering an outer cover of a pneumatic tyre. First remove the old rubber with benzoline; then clean the sulphur from the inside of the cover with a piece of sandpaper or a file-card, and afterwards with benzoline. Fit the cover over the rim so that the wired edges are outside the rim instead of resting on the inner shoulders of the rim. The whole of the cover is then visible, and when the inner tube is slightly inflated to keep the cover round, the rubber can be easily fixed. Give both the cover and canvas or fabric a coat of good solution, and allow it to get quite dry. Then give the canvas another coat, and slip the rubber on evenly when the solution is tacky.

Liquid Boot Polish.—A good liquid polish for boots is made with 4 oz. of gum arabic, 1½ oz. of treacle or coarse moist sugar, ½ pt. of good black ink, 2 oz. of strong vinegar, 1 oz. of rectified spirit of wine, and 1 oz. of sweet oil. Dissolve the gum in the ink, add the oil, and shake together until they are thoroughly mixed. Then add the vinegar and, lastly, the spirit. Keep in a tightly corked bottle. Another method is to mix ¼ oz. of blacklead and 1 dr. of indigo in fine powder in a mortar. Rub them together with a mucilage made by dissolving 4 oz. of gum arabic in ½ pt. of strong vinegar to form a thin paste; then add gradually 1 oz. of sweet oil, and stir them together until thoroughly mixed. Add also 1½ oz. of treacle, and afterwards, successively, 2 oz. of strong vinegar and 1 oz. of rectified spirit, and bottle for use. Both these self-polishing blackings should be applied as thin as possible by means of a sponge.

Gilding Ivory.—In gilding ivory, first remove all dirt or grease, and when the work is dry give it a thin coat of gold size, laid on evenly with a fine hair brush. Then lay aside until set, which may be ascertained by feeling with the fingers. The gold size should be just warm, and it is also advantageous to warm the ivory before applying the gold size. Care must be used to keep the dust away until the gilt is quite dry. Cut the gold leaf in suitable sized pieces, and apply with the tip. The gold leaf can then be pressed into shape with a piece of white wool. When quite dry it can be burnished with an ivory paper-knife or a glass penholder, tissue paper being inserted between the burnisher and the gold. The appearance will be improved by giving the ivory a coat of gold lacquer.

Plane for Making Shavings.—If the wood from which the shavings are to be made is very straight-grained the simplest plan will be to make a plane as illustrated here. Fig. 1 is a longitudinal section of the stock and cross section through the iron B. The shapes of the iron and escapement A are arranged so as not to break the shaving, but to keep it nearly straight while being made, as indicated by the dotted lines C. Fig. 2 is a cross section showing how the iron B is fixed to the stock by means of two bolts. Fig. 3 is a general view of the iron and part of the bolts. The fence F (Figs. 1 and 2), forming part of the stock, will be useful for keeping the plane in position while in use.



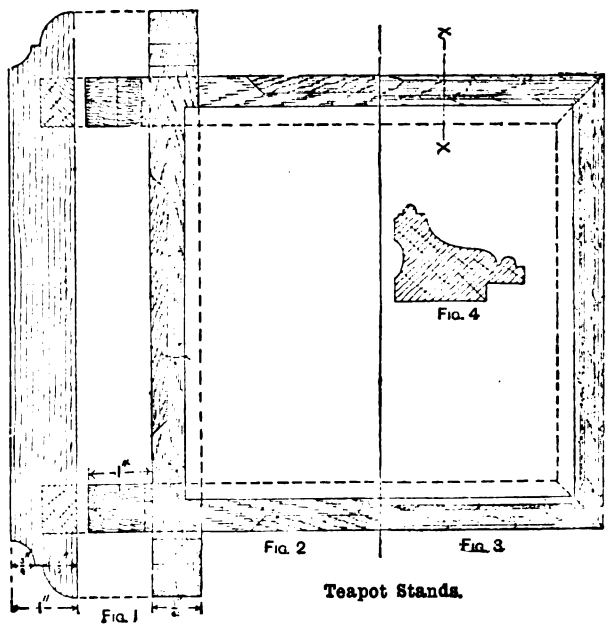
Plane for Making Shavings.

Polishing Wooden Tubes.—In polishing the inside of a wooden tube plug up one end and pour in a quantity of brown hard spirit varnish; then gently tilt the tube from end to end alternately till the whole interior surface is well covered; pour off the surplus varnish, remove the plug, and set the tube aside in warmth to dry. If the shape of the tube will permit, the varnish might be applied with a piece of fine sponge fixed on the end of a cane, something like a lamp mop. Several applications of the varnish may be necessary in order to gain a good result. If the tube can be fixed so that a piece of flannel soaked in French polish can be drawn through with a piece of string, the pores of the wood might in this way be sealed up before the varnish is applied.

Toning Photographic Prints with Platinum.—The following formula for a platinum toning solution is especially suitable for home-prepared plain salted paper. Potassium chloroplatinite 6 gr., water 12 oz., nitric acid 2 drops, or ½ gr. potassium chloro-platinite to every ounce of water made acid with nitric acid. The exact proportion of chloroplatinite to acidulated water is, however, of little account, the greater or less quantity of the salt having no effect except in the time of toning, the colour remaining the same if the prints are toned to the fullest extent. For obtaining bluish-black tones rapidly, 2 gr. of the salt per ounce may be used. The prints should be well washed prior to toning, as any free chloride taken into the bath will readily upset its correct working, if not stop it altogether. As soon as toning is complete, immerse the print in water that has been rendered alkaline with carbonate of soda, for if the print is acid when placed in the fixing bath the hyposulphite of soda will be decomposed, throwing down sulphur and giving yellow whites. The fixing bath also should be kept alkaline with a few drops of ammonia.

Combined Toning and Fixing Bath for Photographic Prints.—The following is a popular formula for combined toning and fixing, and is put forward by the makers of Sollo paper. No. 1: Hyposulphite of soda 20 oz., alum 5 oz., sodium sulphate 10 oz., potassium sulphate 2 oz., water 160 oz. No. 2: gold chloride 15 gr., lead acetate 64 gr., water 8 oz. For use, take 8 parts No. 1 and 1 part No. 2. The red precipitate thrown down in No. 2 redissolves on shaking. It must not be forgotten, however, that the permanency of prints toned in a bath containing alum and lead cannot be relied upon. But according to some workers, there are equal risks of injurious compounds being formed when free silver nitrate is brought into contact with the various impurities contained in ordinary tap water. By using the combined bath the preliminary washing may be dispensed with.

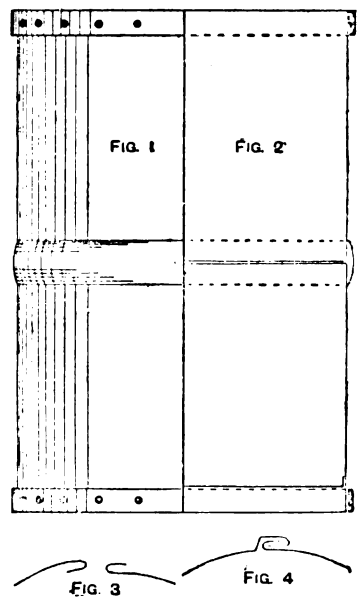
Teapot Stands.—The teapot stands shown by the accompanying illustrations consist of a tile as used for tiled hearths, fixed in a wooden frame. Figs. 2 and 3 show alternative methods of mounting. Fig. 2 is similar to an Oxford picture-frame, except that the rebate is at the front. Fig. 1 is a sectional elevation of one side of the frame. The edges can be chamfered as shown. Fig. 3 shows the tin mounted in a piece of oak moulding, with the corners mitred. Fig. 4 is an enlarged section of the moulding on X Y (Fig. 3). A caddy ball foot should be screwed under each corner.



Teapot Stands.

Preserving Photographs.—A good protection for photographs is afforded by mounting them in optical contact with glass. Place ½ oz. of gelatine in a little water, stand the pot near the stove, and when the gelatine is melted, make up the solution to 10 oz. with water. Place the glass (washed merely and allowed to dry spontaneously) in warm water. Then cut the print about ¼ in. smaller each way than the glass to allow for stretching and for the border, and immerse the print and the glass in the gelatine solution. Bring the glass and the print into contact beneath the surface of the gelatine solution, then withdraw them and squeegee. Back the print with a piece of waterproof backing paper and, when dry, glue on the strut back, and the opaline, as it may be called, is complete. The bevelled glasses and strut backs may be purchased from any dealer in photographic materials.

Making Iron Water Tank.—Iron tanks for holding water are usually constructed of iron which has been galvanised; or when made of black iron, the tanks are subjected to the galvanising process after construction, the latter being preferable, as then the molten zinc soaks thoroughly into all the riveted parts and so renders the tank sound. If there are no galvanising works in the locality, then the first-mentioned method would have to be adopted. A round tank to hold about 30.) gal. of water could be 3 ft. 6 in. in diameter and 5 ft. 3 in. deep. The body should be formed of two equal cylinders placed one on top of the other and joined by a hollowed band round the circumferential seam, each cylinder being first formed of two equal pieces grooved together; the top and bottom of the tank are rendered stiff by riveting iron bands in position as shown by Figs. 1 and 2. Assuming that 20 gauge galvanised iron is used, the four body pieces could be cut from ordinary sized sheets. The pattern would be a rectangle 5 ft. 6¼ in. long by 1 ft. 9 in. deep. Cut out the iron to the sizes given, and then fold over ½ in. on each of the shorter edges, so that when the pieces are rolled to a semicircular shape, the folds would be as shown by Fig. 3. Now place on the mandrel the first pair of half cylinders and join them by working the folds down with a mallet and groover to form a grooved seam, as shown in section by Fig. 4. Now work over a ¼-in. edge round the top of the tank, and turn a length of iron 1½ in. deep by ¼ in. thick to a circle of the same diameter as the tank, holes having first been drilled at suitable distances, so that rivets could be drawn through them when fixing the iron hoop to the tank. Place over the end of the tank the hoop of iron, and rivet it in the position shown at the top of Figs. 1 and 2. Rivet a second hoop round the base of the lower half in the position shown at the base of Figs. 1 and 2. Cut the circle for the bottom of the tank ⅜ in. larger in diameter than the inside diameter of the tank. Work up a ¾-in. edge all round the circle, so that it will fit closely inside the lower end of the bottom cylinder, as shown at the base of the sectional elevation (Fig. 2). Solder the bottom and seams quite sound, using plenty of solder and raw spirits (hydrochloric acid) as a flux. Next cut a strip of metal about 2 in. wide and rather more in length than the circumference of the body, and slightly hollow this along its entire length, working it round at the same time to a circle, or two semicircular pieces of the same size as the body. Place this hollowed hoop over the top end of the lower half of the tank so that it rests round the tank at a distance down equal to the half depth of the rim, and secure this temporarily with light "tacks" of solder. Fit the lower edge of the top half of the tank in the hollowed rim, so that the two edges at the centre of the tank butt up against each other inside the rim, as shown at the centre on Fig. 2. Then solder the band and round both edges. If the tank is made of black iron, the seams down the sides could be riveted, the seam at the centre being joined by riveting a wide band of iron, drilled along both edges for rivets, to both cylinders, the bottom, also riveted in, having a deeper edge set up than for a soldered joint.



Iron Water Tank.

Alloy for Casting Fancy Fruit Dish.—For casting a fancy fruit dish and stand, the following alloy will probably be most suitable. Copper, 60 parts; nickel, 20 parts; zinc, 20 parts; iron, 2 parts; and lead, 3 parts. The iron had best be used in the form of ferro-manganese, and since the latter loses about one-fourth in melting and purifying, it will be necessary to use 2½ parts instead of 2; this will allow for loss. The nickel, copper, and ferro must be melted first under a layer of charcoal; then add the zinc, and, when ready to pour, the lead or the zinc may be used in the form of scrap brass, allowance being made for the copper in the first instance. For a flux to clear the metal, use, for a weight of 80lb. or proportionate, 1 oz. of the following: 1 part borax, 1 part soda, 1 part salt, and 1 part charcoal.

Tool for Grooving Barrels.—A tool for grooving barrels is here illustrated, and is called a cooper's croze. To make it, for the piece shown by Fig. 1 procure beech or oak 16 in. long and 6½ in. wide by 1¾ in. thick. In it cut a mortise A, in which is slipped the upright staff (Fig. 2); this piece is 9 in. or 10 in. long and 1¾ in. by 1½ in., with handles at the ends. The hole B and the slot C in the staff are for the cutting teeth, one form of which is shown by Fig. 3. The side elevation, enlarged,

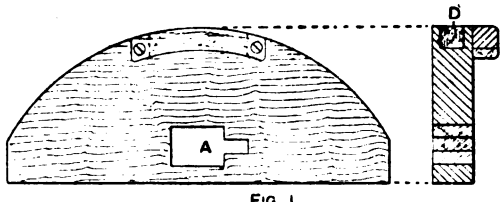


FIG. 1

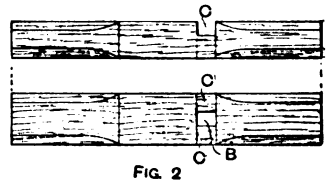


FIG. 2

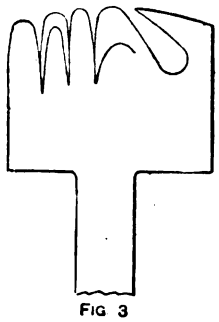


FIG 3


FIG. 4

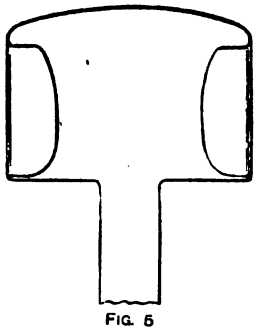


FIG. 5

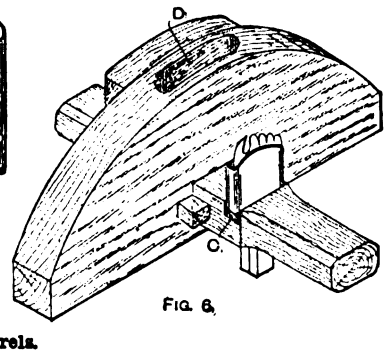


FIG. 6

Tool for Grooving Barrels.

is shown by Fig. 4. Place it in the guard case (Fig. 5), then put the two together in the hole B (Fig. 2), as shown in Fig. 6. Fasten up with an iron wedge, if required, and finally wedge the staff tight with pegs. In the slot D (Figs. 1 and 6) the left hand is placed to give grip and to protect the fingers when the tool is being worked; if preferred, a hole may be cut through the timber for the same purpose, but is hardly so satisfactory. The movement should be from right to left, or towards the operator.

Fruit Syrups.—There are many kinds of fruit syrups which are made from the real fruits, while others are made from water, colouring matter, sugar, and flavoured with essences; the flavour of the former is greatly superior to that of the latter. The beneficial action of the fruits is obtained by using the real fruit juices, and they are therefore to be preferred. The requisites for making the following fruit juices are fresh fruit, sugar, hot water, and a few household utensils. *Blackberry Syrup.*—Take 4 qt. of ripe blackberries, place them in a preserving pan, and add sufficient water to rather more than cover them. Place the pan on a slow fire and allow them to stew slowly for two or three hours. Then strain through a hair sieve or a piece of fine muslin, afterwards pressing the residue so as to obtain as much of the juice as possible. Place the juice again in the pan, and for every pint add half a pound of fine white granulated or lump sugar. If desired, a flavour may be added with a few cloves and a pinch of allspice. Allow the liquor to boil and stir well until it forms a thick rich syrup. This boiling may extend to twenty minutes or half-an-hour, but take care that it is stirred well or the sugar will burn in the pan and spoil the flavour of the syrup. Allow the syrup to cool somewhat, and while it is cooling prepare the bottles to receive it. They should be washed first with warm soda-water, and then with clean warm water. New corks should be used, as old ones generally spread a fungous growth and make the syrup mouldy. Fill the bottles with the syrup and cork at once. This syrup makes a delightful drink; a tumbler should have about a quarter of a glassful of syrup and be filled with cold water. A piece of clean ice will make the drink exceedingly refreshing. Sodawater used instead of ordinary water makes it an aërated beverage far above the bottled compounds. The sodawater may be obtained either from a seltzogene, syphon, or penny split, but the sodawater powders would not do for this purpose; aërated water is all that is required. *Strawberry Syrup.*—Mash a quantity of ripe strawberries, allow them to stand in a cool place for several hours, and strain. To every pint of juice add 1 lb. of sugar and place in the preserving pan, boiling for twenty minutes, after which bottle and seal the juice while hot. *Red or Black Currant Syrup.*—Take 1 qt. of red or black currants, place them in the pan, and cover with water. Boil for about half an hour, then strain away the fluid part and replace it in the pan. Then boil gently until the fluid is reduced to about 1 pt., and add 1 lb. of sugar. Boil for twenty minutes, and bottle. Less black currants may be used if desired, as they produce a very strong syrup. The red currant syrup produces a very good tonic drink when used with water or sodawater, and the black currant, owing to its astringent properties, may be used in its undiluted state as a gargle for weak or sore throats, as well as in the dilute state as a remedy for diarrhœa. *Cherry Syrup.*—Take a quantity of Morella cherries and, after cleaning them, cut them in halves with a knife, place them in the pan, and cover with water. Boil slowly for several hours until quite soft, then strain off the juice, put it back in the pan, and, allowing 1 lb. of sugar and two cloves for every pint of juice, boil for fifteen minutes and bottle. This syrup should be used with water or sodawater. *Strawberry Shrub.*—Take 6 lb. of sound ripe strawberries, put them into an earthenware bowl, add 2½ oz. of tartaric acid, mash the strawberries, and add 1 qt. of water; then allow the mixture to stand in a cool place for forty-eight hours, and filter it through a flannel bag. Add 3 lb. of granulated sugar, and stir until all the sugar is dissolved; then bottle and seal up. Keep the bottles in a cool place till required. To make the shrub, take 1 pt. of water and add four or five tablespoonfuls of the shrub. *Portable Lemonade, or Lemonade While You Wait.*—Take 1 lb. of fine white sugar, known as icing sugar, or powder granulated sugar in a mortar. Grate the rind of four large juicy lemons and mix with the sugar. Press the four lemons to obtain the juice, which should be strained, and mix this also with the sugar. Now place the mixture in glass jars, which may be corked or covered with clean bladder. When the lemonade is required, stir a tablespoonful in a glassful of water. For an aërated lemonade, place a tablespoonful of the mixture in a glass tumbler of ordinary size and fill up with plain aërated water.

Preparing Lard for Ointments. — Lard for ointments must be made from the fat of the abdomen (the leaf) of the pig. It must be chopped into small pieces and rendered in a jar placed in a pan of hot water kept at a temperature of 135° F. The clear fat is strained off and the residue pressed to obtain the remainder. For soft ointments, olive oil is sometimes mixed with it; and for harder material, beeswax is added, forming "cerates." Benzoated lard is made by heating together for two hours 1 lb. of lard and 210 gr. of gum benzoin, and then straining.

Mounting and Preserving Leaves. — In making a collection of leaves the following points should be attended to. (1) The leaves should be taken only from trees the names of which are known to be quite authentic. (2) They should truly represent the average size of leaf that is common to the species. (3) They should be perfect with regard to contour—many leaves are not so. (4) They should only be of such as are fully matured, yet without being so old as to have lost colour. As regards colour, no preserving solution is necessary if, during the whole of the curing process, the leaves are kept from the action of air and light. Immediately the leaves are brought in from the field they should be arranged neatly and placed flat between the pages of a thick heavy book. Quite ½ in. of empty pages should lie between any two leaf specimens in order to ensure even distribution of pressure. When filled, the books may be placed under a screw book-press, or pressed with some heavy material up to at least 150 lb.; if 200 lb., so much the better. The leaves should be allowed to remain under pressure for fully six weeks. The chief mistake in leaf curing is that the leaves are relieved of pressure and exposed to the light too soon. It will be an advantage, however, to change the leaves to new places in the books at the end of the second day. This should be carried out in the evening, when the light is not strong. If the above instructions are carried out, the natural colour of the leaves will be retained nearly to perfection. A good way of mounting the leaves for class use, or for show purposes, is to obtain a number of oblong pieces of stout white cardboard, to which the leaves are fastened by means of narrow strips of gummed paper. After the leaf is duly labelled, glass fronts, of exactly the same size as the cardboard, are placed over the leaves and fastened to the cardboard backs by black binding strips about 1 in. wide, as shown in Figs. 1, 2, and 3. Black paper, with a glazed waterproof surface, known as lining paper, may be procured of any bookbinders, and is very suitable. The binding strips are cut to exact length both ways, but a small allowance is made for lapping at the mitred corners, as shown at A, B, and C in Figs. 1 and 2. These separate specimens may afterwards be mounted collectively in one large frame, as shown by Figs. 4 and 5. The construction of this frame is simple; the back is of ½ in. matchboarding, screwed to the rabbeted ledge pieces seen in the front and side views.

Cleaning Silver Chains. — To clean silver chains quickly, rub well over with rouge powder rubbed up in best sweet oil. Boil off in clean hot water and polish with dry rouge, finishing with ground whiting.

The Wood-borer Beetle in Timber.—Text-books say little or nothing about the wood-borer beetle, and the following is the result of an expert's independent observations. The holes are made by the small, white, maggot-like larva of the beetle, which belongs to the true beetle family (the *Coleoptera*), and, in common with the other members of the same family, has its flying wings covered over by two outer false wings or sheaths, that are of a hard and horny texture. There are (to be exact) three branches of the beetle family that commit ravages in wood. The *Ptinus* and *Anobium* genera are chiefly responsible for the holes that appear in old furniture, roofs, and all interior woodwork. The *Lymoxylon* confines its operations mainly to oak timber that is kept in wood-yards near the sea. This latter is a borer of comparatively recent introduction, and on account of its liking for the vicinity of the sea is generally known as the "dockyard borer." In their operations the three kinds behave exactly alike. First, the eggs of the mother beetle are deposited on or just under the surface of the wood, where they stay until the larvæ are hatched. The larva, when it is strong enough, begins to bore a passage deeper into the wood, filling up the tunnel as it goes with fine white wood powder. At a certain stage of its progress the usual transformation cocoon is made, and at the end of the resting period the changed insect emerges in the form of a small winged beetle. The remedies are:—(1) Fumigation in a closed chamber with pungent and noxious fumes. (2) Steeping the articles affected in solutions of poisonous chemicals, such as bichloride of mercury, copper sulphate, chloride of calcium, iodide of potassium, etc. (3) The application by hand of various oils and spirits, as petroleum, benzine, chloroform, and alcohol. (4) The most recent recommendation is the use of a 15 per cent. solution of hydrogen peroxide, well brushed over the wood. (See also Series I., pp. 120 and 301.)

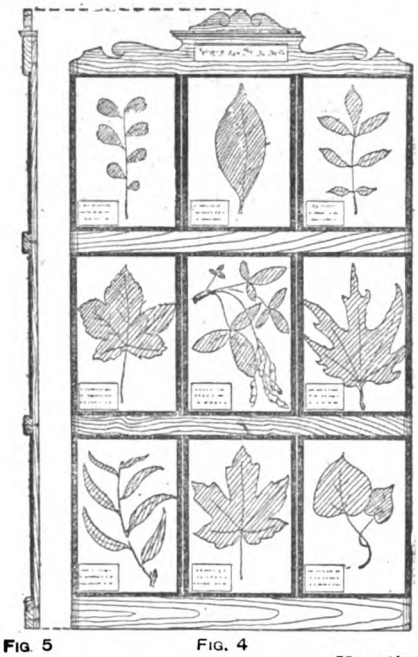


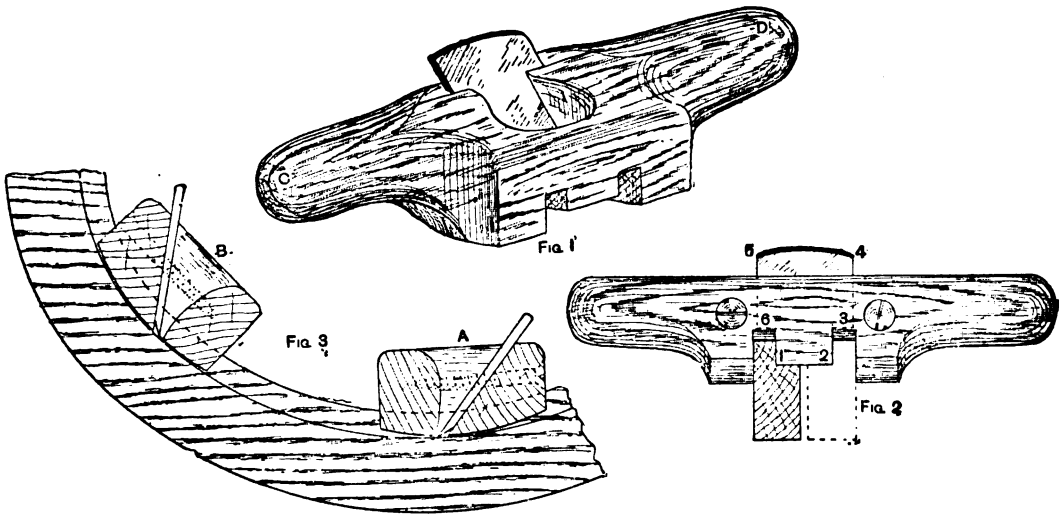
FIG. 5

FIG. 4 FIG. 2 FIG. 3

Mounting and Preserving Leaves.

Black Enamel for Cycle.—Enamel-making requires special experience and plant, but here is a recipe for a cycle enamel that will dry quickly and will not chip off. Boil 6 gal. of linseed oil for two hours, and melt down 10 lb. of asphaltum and 2 lb. of gum animi in the gum pot, and when properly fluid pour into it slowly, while stirring, 2 gal. of the boiling oil; when the three are properly amalgamated, pour them into the remainder of the oil in the boiler. Continue boiling and stirring for several hours, and add gradually in fine powder 1¼ lb. of red-lead, 1½ lb. of litharge, and ½ lb. of copperas. When a portion of the varnish taken out on an iron rod will draw into strings, put out the fire and allow the material to cool somewhat, then add gradually, with constant stirring, 10 gal. of turpentine.

Rebating Solid Oval Frames.—A router suitable for rebating oval frames and similarly shaped work is shown by Fig. 1. It is made double so that it may be worked in either direction according to the grain of the wood, as indicated at A and B (Fig. 3). The stock should be made to shape, and two screws inserted so as to fit tightly. These should next be taken out and the stock sawn into two parts lengthways, as indicated by the line C D (Fig. 1), and at the same rake as the iron. The iron should next be let into the back portion of the stock to not quite its thickness, so that when the two parts are screwed together, the iron will be firmly gripped between them; this will avoid the use of a wedge. The mouth and throat should next be made. The upper part of the iron is made wider so as to be gripped by the two parts of the stock, leaving the mouth and throat the full width of the cutting edge of the iron; this will prevent choking while in use. The shape of the iron is shown at 1 to 6 (Fig. 2).



Router for Rebating Oval Frames.

Gilding Fretwork.—Articles made of fretwork can often have their appearance improved by gilding. Should the centre portion of a fret panel be in the form of a lyre or vase, for example, that portion may be gilt with advantage; photo frames also, if gilded all over, have a good appearance. When gilding a centre portion only, it will generally suffice if the face portion only is gilded after the fretwork has been polished; on the other hand, a photo frame or article to be mostly gilt will be greatly improved if all wood not to be so treated is finished in a colour closely resembling gold. Whether the article is to be partly or wholly gilded, the groundwork must be specially prepared. The grain of the wood should be filled, and French-polishing the frets is a good plan; in fact, if the article is finished with a perfectly bright level surface, the gold will have a somewhat burnished appearance when finished. Remember, also, that with articles only partly gilded the darker the groundwork the finer the effects; thus, articles finished out dark, walnut, rosewood, or black, will look superior to those finished light or made of light woods as common mahogany, sycamore, or birch. In the case of articles to be entirely gilded, all interstices and outer edges should be coated with chrome yellow or yellow ochre mixed in 1 part polish or spirit varnish and 3 parts spirit; several coats should be given till a dead solid colour has been gained. As it is practically impossible thus to coat the edges without getting the colour on the face of the article, an effort should be made to coat all portions alike, which is best accomplished by placing the article on a sheet of newspaper and stippling the colour well in with a camel-hair brush; after the preparation is quite hard, the face portion that is to be gilt may be smoothed with fine worn glasspaper before polish, varnish, or gold size is applied. It is well to finish all polishing of the frets before any gold is added, and as all recently polished work has a somewhat greasy or tacky feeling without being so adhesive that the gold leaf may be applied direct, it is a good plan to dust the article with dry whiting tied in a muslin bag or, better still, to add 1 gill of water to the white of an egg, mix thoroughly, and coat the article with this preparation, which will dry in a few minutes. To gild the article is an easy matter if the gold leaf is procured on transfer paper; it can then be cut to avoid waste. The parts on which the gold leaf is to be fixed should be coated with gold size. Using a camel-hair or sable pencil, carefully cut in the design. Then, if the whole of the article is to be coated, the gold size must still be evenly applied; avoid as far as possible running down the interstices or the forming of fat edges. For a small amount of gilding, it will suffice to procure a small quantity of japanners' gold size, which should dry fit for use in half an hour; but for large quantities of goods it may be desirable to use a gold size which acquires the proper tack in periods ranging from six to twenty-four hours. An adhesive drying in six hours may be made by mixing one-third japanners' gold size with two-thirds oak varnish; by adding "fat oil" to varnish its drying may be retarded for several days. Whichever kind of adhesive has been used, the preparation should, before the gold is applied, acquire a proper tack; then just before drying hard the size acquires such a stickiness that when the knuckle is pressed against it there is a slight pull. Next take a piece of transfer paper, and with a steady hand place the gold leaf where desired, press down with the finger, then lift off the paper. Repeat the operation as often as is necessary, taking the precaution to allow each succeeding piece slightly to overlap the one just laid on. When the whole of the work is covered, press on the gold with a tuft of wadding or a dry camel-hair brush. Should any portion appear uncovered or not quite solid, lay on another piece of leaf. This done, take a piece of sponge with clean water and wipe over all the work to remove all whiting or egg-size and all gold that has adhered where not required. Should this treatment fail to remove all surplus gold, use a rag on which is a trace of turpentine. If the polished surface after this has a tarnished appearance, it may be easily freshened by a polish reviver, a glaze rubber, or by the application of thin spirit varnish. "Fat oil" may be made by placing raw linseed oil in a wide-mouthed glass jar covered with muslin to exclude dust. Set this aside where the sun's rays may fall upon it; in a few weeks' time it will become clear and "fat," and ready for use.

Patterns for Umbrella Covers.—The dimensions of patterns for umbrella covers vary slightly, but the following will be found about right. The dimensions allow for the seams. For a 19-in. cover, 18¾ in. by 13¼ in.; for a 20-in. cover, 19⅜ in. by 13¾ in.; for a 21-in. cover, 20⅛ in. by 14 in., or 21 in. by 14½ in.; for a 22-in. cover, 21⅛ in. by 14¾ in.; for a 23-in. cover, 22¼ in. by 15¼ in.; and for a 25-in. cover, 24⅛ in. by 16¾ in. Make a cheap cover before cutting out the zinc patterns, and try it on a frame. Some people prefer the covers more semi-globular than others. The London made covers are as a rule flatter than the provincial makes. The measurements are along the side of the gore and across what will be the hem when the cover is finished. For instance, a 20-in. cover is 19⅜ in. long upon the edge where it is seamed to the next gore, and 13¾ in. across the selvedge end.

Folding Camp Bed.—Figs. 1 and 2 show a folding camp bed opened and rolled up respectively, whilst Fig. 3 is a side view, and Fig. 4 an end view. An ordinary size would be 6 ft. 6 in. long by 2 ft. wide. Ash or similar wood will be most suitable for the sides and legs. The side pieces should be about 2 in. square, and when smoothed up the edges should be planed off a little. The legs should be about 1 in. thick and 2 in. wide for the greater part of their length, increasing to 2½ in. near the upper end. The top ends of the legs

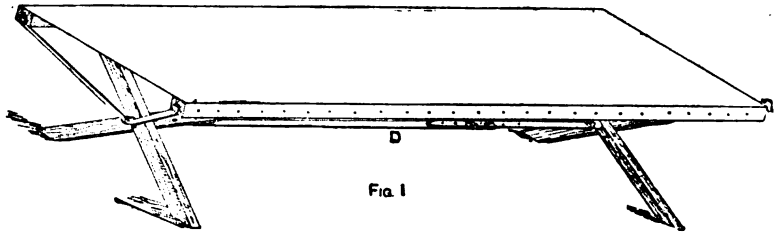


Fig. 1

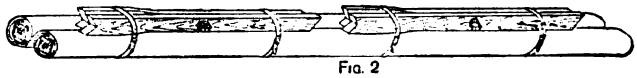


Fig. 2

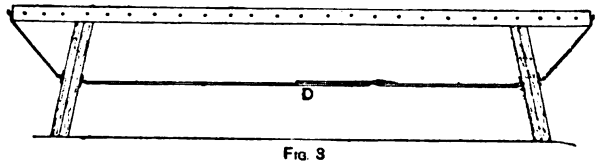


Fig. 3

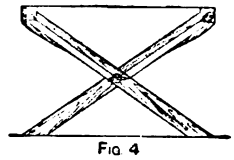


Fig. 4

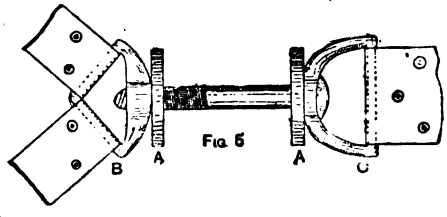


Fig. 5

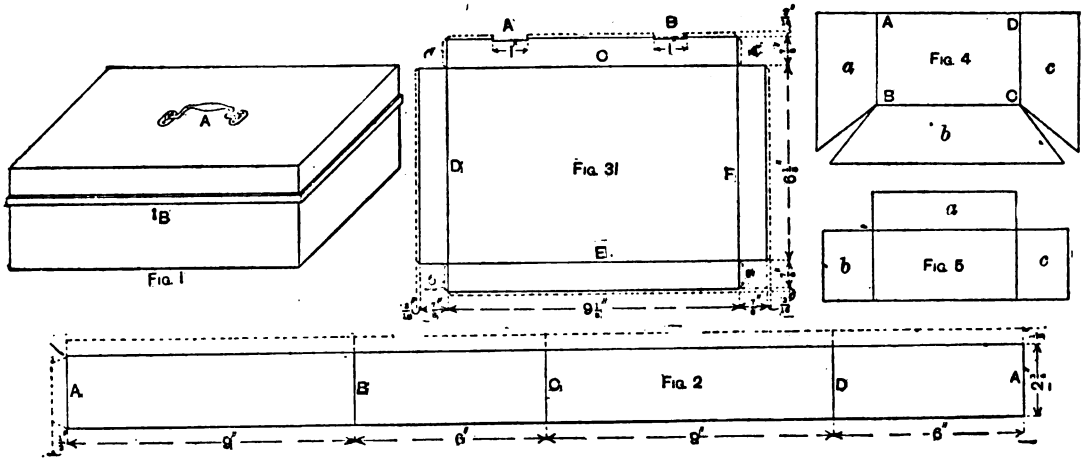
Folding Camp Bed.

are cut bird's-mouth shape (see Fig. 4), so as to clip into notches about ½ in. deep made in the side pieces; by this means, and by the straps shown, the legs can be firmly kept in position. Fig. 5 shows one of the iron bolts, with washers A, to keep the legs together, and the connecting pieces B and C for straps. It will be observed that the end straps connect to a hook at the ends of the side pieces, and the legs are held firmly in position by the larger strap (marked D in the drawings) connecting them. The bed should be of strong canvas or similar material firmly nailed to the side pieces.

Notes on Chimney-pieces.—In the case of ordinary dwelling-houses the choice of chimney-pieces for the more important rooms is generally limited to those made of marble or enamelled slate, or of wood. Iron mantel-pieces are used at times; stone chimney-pieces, however, are not very suitable for residences, as a rule, except in kitchens or scullories. Of marble chimney-pieces those made of Sicilian marble are in great demand and are cheap. A rather more expensive marble is called "Vein" marble, having darker veins that run through the white. Amongst the coloured marbles a very popular one is the deep red Belgian marble known as "Rouge" or "Rouge Royal," in which the veins are light; but this marble may require stopping at times, like many others of the coloured marbles. It is comparatively inexpensive. Another kind in common use, but rather more costly, is that known as St. Anne's, a strong, durable marble from Belgium. Other kinds of coloured marble are used, as is also black marble sometimes. Coloured marble chimney-pieces such as Rouge Royal are often relieved and ornamented by having black marble for mouldings, or small circular pieces forming "buttons," etc. In selecting chimney-pieces, not only should the workmanship be examined, but also the marble, to see that it is all sound and of good quality. Enamelled slate chimney-pieces are usually black, and have inlays of green or red spars, etc., in piers and frieze. They cost much the same as chimney-pieces of Sicilian marble. Marble chimney-pieces are usually described as "flat jamb" or "boxed" respectively; the former are hardly suitable for the more important rooms, but would do well enough for smaller bedrooms. They are generally made with piers 6 in. or 7 in. wide, while the boxed ones can be had from about 7 in. to 14 in. in width; the shelf 1 in. wider than the jambs is a very good proportion. With stone chimney-pieces, the scantling of the jambs and mantel should be governed by the width and height of the chimney opening. The thickness might vary from 1¼ in. to 2 in., and the width from 7 in. to 9 in. or thereabouts. The usual fixing is, of course, by means of plaster and cramps. Doubtless, from an artistic point of view, wooden chimney-pieces are to be preferred to others. They have also many other advantages; they can be made so as to suit cases in which the stone is fixed flush with the faces of the plastering or otherwise. If a comparatively inexpensive chimney-piece is desired, the design may be at once tasteful and suitable, and pine may be selected as the material of which it shall be constructed, thus reducing the cost to possibly half what it would be in hardwood for the same article; and whitewood could be substituted for pine at a slight increase of cost. If the painting is artistically done, very pleasing effects may be obtained, even with these inexpensive woods. If the chimney-piece is made in hardwood, the oak may be oiled, or fumigated with ammonia and beeswaxed. With the other usual hardwoods it could be French polished. A great protection from fire is afforded by fixing a marble slip as a margin round wood chimney-pieces. In some of the plainer designs, the jambs vary from 6 in. to 8 in. wide, shelves 7 in. to 8½ in., and lintels 10 in. to 13 in. deep. Some of the finer chimney-pieces can be had with compo mounts if desired. As regards iron chimney-pieces for ordinary register stoves, little need be said except that with some patterns an extra-deep flange can be had, causing the chimney-piece to project some 3 in. or 4 in. more than with the ordinary flanges, but the cost is extra.

Chemical Chimney Cleaner.—The following is the composition of a chemical chimney cleaner for removing soot protected by patent 7820 of 1898. Half a pound flowers of sulphur, 3½ lb. chloride of sodium, 2 lb. potassium nitrate, 3½ lb. cuprous sulphate, and 4 lb. muriate of ammonia. Red ochre may be added if it is desired to colour the mixture. All the ingredients must be thoroughly pulverised before mixture. A little is thrown upon the fire, and the gases given off by combustion destroy the soot.

Cash-box in Sheet Metal.—Fig. 1 represents a sheet metal cash-box 9 in. long, 6 in. wide, and 3½ in. deep including the lid. Any sheet metal such as copper or tinplate may be used in the construction of the box, whose body is set out as in Fig. 2. Notch the top edge at B, C, and D to a distance of ½ in., and then set it off along a sharp stake and beat it down on to the body. Bend sharply and at right angles to the body the ¼-in. lap at A, and bend also B, C, and D in the same manner, and solder together. Two strips are cut ½ in. wide, each equal in length to the distance A B, and two equal to B C, plus allowances for mitres; these are for the beads on which the lid rests. A ¼-in. edge is turned up square along each edge of the strips, which are then mitred square and fixed on the body, ½ in. from the top edge. The bottom is cut ½ in. longer and wider than the body; edge it to fit tightly, and then solder it in place. The lid is set out as in Fig. 3, and is notched at A and B for the hinges. Bend the laps *a*, *b*, *c*, and *d*, and turn upsquare along the lines C, D, E, and F, afterwards soldering the corners with the laps inside. The ¾-in. edge is now set off outwardly, and wired with a length of thin wire. Two pieces of tin 1½ in. by 1 in. are bent over the exposed wire at the notches A and B for the hinges, and are then sunk in a crease-iron. A brass fall-down handle, shown at A (Fig. 1), is then fixed in position in the centre of the lid, which can next be fastened to the box with the hinges inside. A box for



Cash-box in Sheet Metal.

the lock is shown in Fig. 4, A B C D being the plan of the lock. The *a*, *b*, and *c* parts of this pattern must be arranged so that when they are bent and soldered in position, the edges will be flush with the highest part of the lock. Solder the lock in the box, cut the keyhole B (Fig. 1), and solder the box in position. Fig. 5 is a pattern for the box which will be required for the top part of the lock, the parts *a*, *b*, and *c* being as wide as the top plate of the lock. Bend these parts square, and solder the corners from the inside. Fix the box to the lid, and the top plate to the box. The following is a satisfactory method. Lay a piece of brown paper over the lock, push the eyes of the top plate through the paper so that the lock will answer freely to the key, and place a body of solder on the top-plate and on the box. Let the fastening be unlocked, and with a hot iron melt simultaneously the two bodies of solder, and instantly bring the lid down and turn the key. When the metal is cool, the box can be unlocked and the soldering completed with a cooler iron. On completion the box can be cleaned thoroughly, and it can then be enamelled to any colour desired.

Polishing Cheap Furniture.—Most polishers give cheap deal furniture one or two coats of glue or patent size, heavily tinted by adding venetian red. Apply hot with a brush and rub in lightly with a piece of rag; in the case of mouldings and turned work get it well in the quirks and finish off in the direction of the grain. When dry, smooth with worn glasspaper, then give two or three wet rubbers of French polish without a rag covering to prevent the grain rising. Now apply at least two coats of spirit varnish; an interval of half an hour should elapse between the application of the first and second coats. When the last coat has stood about an hour, level it with a polish rubber, this time with a rag covering; make the rubber fairly wet with half polish and half spirit, and keep the face free from creases. Put a few spots of oil on the face of the rag and apply to the varnished surface with a light swinging motion, circular, then straight; repeat until the varnish is fairy level and the grain appears filled up, then apply another coat of varnish and set aside till next day. On again taking up the work, smooth down with glasspaper, if necessary, then apply more polish till the surface appears to be sufficiently solid. The brilliancy of the surface may be considerably enhanced by adding a few drops of glaze to the rubber, applying the latter with a light, straight motion, taking care not to tear up the lac surface instead of levelling it. The polish and varnish used should be tinted mahogany colour by adding to each of them a small quantity of red stain, which can be made by dissolving one pennyworth of Bismarck brown in ½ pint of methylated spirit.

Testing Linseed Oil.—The specific gravity of linseed oil varies between ·932 and ·937; most other oils that could be used as adulterants of linseed oil have a lower specific gravity, cotton and hemp seed oils being ·930, walnut oil ·929, poppy seed oil ·926, sunflower seed oil ·925, earth nut ·918, and colza ·914; mineral oils have a lower gravity still, while resin oils have a very high gravity, hence the specific gravity is a guide to the purity of linseed oil. The drying power of oils is directly proportional to the amount of oxygen they are capable of absorbing, hence Linache's test is a good one for the purpose. A large watch glass is taken, and upon it is spread about 1 gramme of precipitated lead; the watch glass is then weighed, the oil, about ·6 gramme or ·7 gramme, is dropped upon the lead, and the whole weighed to get the exact amount of oil taken; the watch glass is then exposed to light in a place free from dust; after two days the glass may be again weighed. Linseed oil treated in this manner gained 14 per cent. in weight, while walnut oil gained only half that amount, and the other oils much less. Maumene's test is also very useful and is easily performed. Fifty grammes of the oil are weighed out into a beaker, and this is placed in a larger beaker, the space between the two being filled with cotton wool; 10 c.c. of concentrated sulphuric acid are run gently into the oil from a burette, the oil being stirred with a thermometer during the operation. The oil is charred and decomposed by the acid, the temperature rising considerably; linseed oil yields a rise of temperature of 103° to 124° C. Some of the fish oils give an equal or even a greater rise, but the other seed oils are much lower, cotton seed oil being about 75° C. To determine the rise, the temperature of the oil before the experiment is deducted from the highest temperature recorded. The best tests used in the laboratory are the refractive index, that is, for linseed oil 1·481 at 15° C., and the iodine equivalent 170 to 183. Boiled linseed oil has a gravity of about ·945, and in other particulars differs from the raw oil. To get any result from the weight of a gallon of the oil it would be necessary to measure the oil very carefully; 1 gal. of linseed oil will weigh from 9 lb. 5½ oz. to 9 lb. 6 oz. nearly, as against 9 lb. 4½ oz. for cotton seed oil, so that there is very little margin for error in conducting the test.

Applying Theatrical Grease Paints.—Grease paints are applied by rubbing the end of the stick on the face. If the paints are properly made the warmth of the face will moisten the colour when applied; soften off with the fingers. In painting a clown's face, or where distinct lines are required, place a piece of the colour in an iron spoon and hold the latter over the gas; when the colour has melted, apply with a camel- or sable-hair pencil.

Trestles and Board for Paperhanger.—Fig. 1 is an elevation and edge view of one portion of a paperhanger's trestle; Fig. 2 is a general view of the complete trestle. The trestles should be made of about 1½-in. by ½-in.

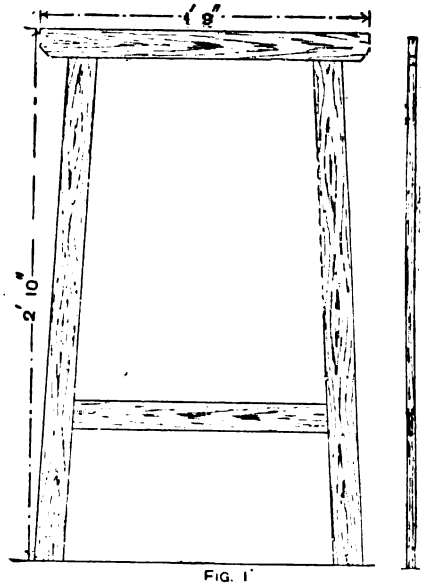


FIG. 1

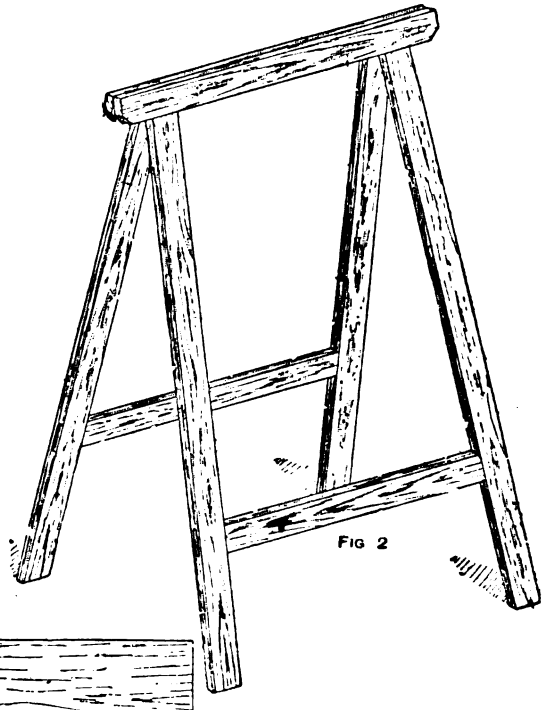


FIG. 2

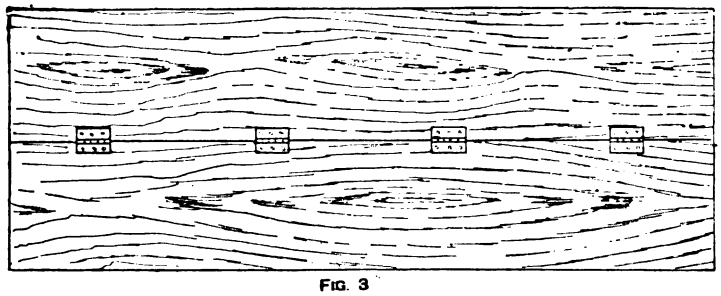


FIG. 3

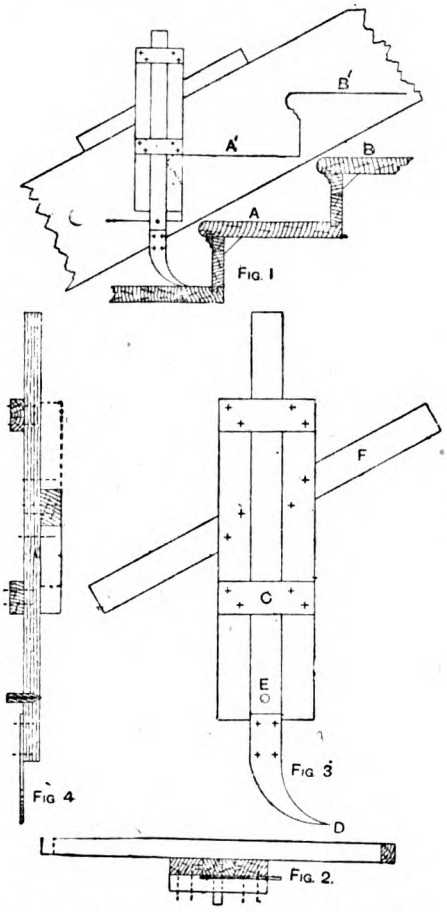
Trestles and Board for Paperhanger.

material mortised and tenoned, the two parts being hinged together with 2½-in. back flaps. The board should be formed of two pieces of pine 11 in. wide and about ½ in. thick; these should be jointed and hinged together from the underside, as shown at Fig. 3.

Floor for Cow-shed.—Hard common bricks set on edge may be used for the floor, but blue Staffordshire bricks will last longer. The front portion of the standing, for a distance of about 3 ft. from the manger, should not be paved, but should have the floor made of rammed chalk or some such material, so that the cow will not injure its knees in lying down. The paved portion of the floor should have a slope to the back, where a channel 12 in. or 18 in. wide runs across the end of each stall. The channel should be 4 in. or 5 in. deep at the side furthest from the cow, and 2 in. or 3 in. deep at the other side. It should be continued as an open channel from one end of the shed to the other, and should be carried through an opening in the end wall. In laying the pavement the brickwork will be made more secure at the edge of the gutter by putting a row of bricks on end, with their edges to the gutter, and the same arrangement may be adopted at the front end of the paving. A concrete floor, cemented and furrowed, would also be suitable, but whether it would be cheaper than a brick floor would depend on local prices. After taking out the earth to the required depth, a bottom layer of concrete may be put in 4 in. thick. This may be composed of 1 part of Portland cement, 2 parts of sand, and 5 parts of broken stone, brick, or good hard clinker, broken to pass through a 2 in. ring. When this has been laid, beaten down with the back of a spade and left for a few hours, but before it is set quite hard, a top dressing 1 in. thick may be put on. This should be made of 1 part of Portland cement to 2 parts of ¼-in. granite chippings, and trowelled over to a smooth surface. To make a foothold for the cows, grooves should be made in the floor, cutting the surface up into squares about 2 in. across. The grooves are made by a wooden straightedge with a bevelled edge pressed down into the newly laid cement.

Particulars of Aquafortis.—Aquafortis is the common name given to commercial nitric acid; the name means "strong water." Strong nitric acid is employed as a depolariser in the porous cell of a Bunsen battery. When partly spent by this work, it is named "dipping aquafortis," and is used to clean copper and brass from oxide. It is also used with sulphuric acid and hydrochloric acid in making "dipping pickles," employed for various purposes in the plating shop. By itself, or when diluted with water, it will dissolve silver, copper, brass, and iron. When mixed with sulphuric acid, it will dissolve nickel. When mixed with muriatic acid, it will dissolve gold and platinum.

Scribing Skirtings to Stairs.—The accompanying illustrations show a simple and accurate appliance for scribing skirtings, etc., to stone, wooden, concrete, or other stairs. It can be made a more complicated and highly finished appliance, but its most easily made form is here shown. Fig. 1 is a general view of the skirting board and appliance in position ready for scribing. On it are reproduced the outlines A′ B′ of the treads and risers A and B as they are to be cut. Figs. 2, 3, and 4 show respectively sectional plan, elevation, and sectional elevation to a larger scale. To construct the appliance, commence with the blade C (Fig. 3). Take two pieces of pine, 15 in. by 1½ in. by ¾ in., and groove the two inside edges as shown on sectional plan (Fig. 2). Take another piece, 21 in. by 3 in. by ¾ in., and tongue it on both edges. Put these



Appliance for Scribing Skirtings to Stairs.

together, and screw two pieces on the face, keeping the lower one up some distance from the bottom, say 8 in. The centre piece must glide steadily and easily. At the bottom of the centre piece, which is now termed the glider, a piece of ⅛ in. iron is cut or bent to the shape shown, and screwed on. This must be brought to a chisel edge, care being taken to see that no part of it touches the stair except the chisel edge D. A hole is now bored in the glider at E to receive the pencil or other marker. The height of the hole from the bottom of the iron is determined by the amount of stuff there is to come off the back edge of the skirting. The boring of the hole is an important detail. If a pencil be used to reproduce the outline of the stair on the skirting, it is essential that the bore should diminish from the thickness of the pencil to a point, where it comes through on the marking face. Otherwise the point will shift, and that will produce undesired variations in the scribing. The stock F is made about 18 in. by 2 in. by 1 in. or thicker to suit the thickness of the skirting. The scriber is now ready to be applied, and is done as follows. Lay the skirting board on the nosings of the stair, and close up to the wall or framing, place the stock on the top edge of the skirting, place the blade on the face of the skirting, making it vertical, and screw it to the stock as shown on general view (Fig. 1). Having put a pencil in the hole E, lay the hand lightly on the stock, so as to keep it always lying on the edge of the skirting. Let it glide gently down the edge of the board, at the same time keeping the chisel edge of the iron always in contact with the stair, and there will be reproduced on the skirting a facsimile of the outline of the stair. These lines, if cut by a skilled mechanic with hand and key-hole saw, will give a satisfactory result. The screws are represented by crosses in the elevation, and by dotted lines in the section.

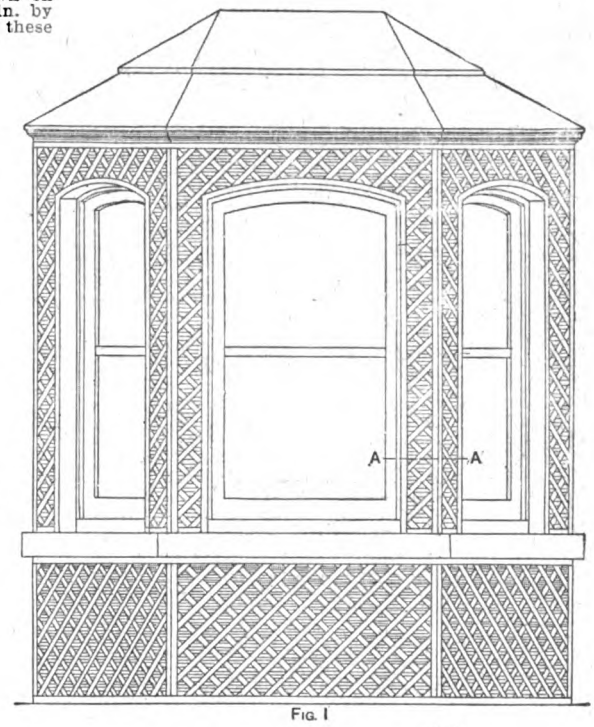


Fig. 1

Trellis Work on Bay Window.

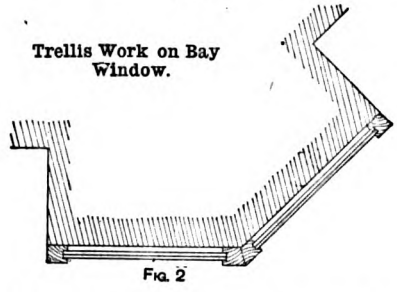


Fig. 2

Fixing Trellis Work to Bay Window.—The brickwork of a bay window may be covered with trellis work in the following way. Plough grooves to receive the trellis work should be made in some 1-in. by ¾-in. deal strips; these should be fixed to the angles of the brickwork, as shown in the illustrations. If the segments of the window heads are sharp, it will be necessary to cut the strips to the curves, as the strips will not bend. The trellis work can next be cut between so as to fit in the plough grooves, and fixed with brads. Fig. 2 is a horizontal section through the pier at A A (Fig. 1).

Green Polish for Picture Frames.—Below is a recipe for a green polish as used on oak picture-frame mouldings. These should be perfectly free from dirt and should be well cleaned up, and then stained with a mixture composed of 2 oz. of verdigris and ¼ oz. of indigo, dissolved in 1½ pt. of vinegar that has been brought to boiling point. Apply hot; two or three applications may be necessary. For a dull finish, beeswax and turpentine, well rubbed in, will suffice; but for a bright French-polish finish, the grain must be filled in with finely crushed whiting tinted with Brunswick green made up into a paste of the consistency of thick paint. White or transparent polish made from bleached shellac must be used. A green tint may be given to the polish by adding a small quantity of aniline dye, soluble in spirit; two kinds of aniline dye are sold—one soluble in water, the other in spirit.

Case-hardening Furnace.—Fig. 1 is a longitudinal section and Fig. 2 a cross section of a small case-hardening furnace; it has an interior area of 5ft. by 1ft. 9in. and is 2ft. deep, but these dimensions may be varied to suit requirements. The furnace is constructed of brickwork, which must be good, sound, and well bedded. The outer case is lined with best quality firebricks fixed with fireclay. A flue is constructed at one end and carried into a chimney-stack at least 15ft. or 16 ft. high so as to secure a good draught. At the front end opposite the flue is the arrangement for the fire-hole. The bars are fixed in angle rails as shown in Fig. 1 and open to the front, this opening being covered by a cast-iron door sliding in and out. Two openings of one brick (9in. by 3in.) should be left on each side of the brickwork to admit air; these openings should be closed by iron slides as described above and shown in the illustrations. The straight-hatched portions indicate ordinary brickwork, and the curled-hatched

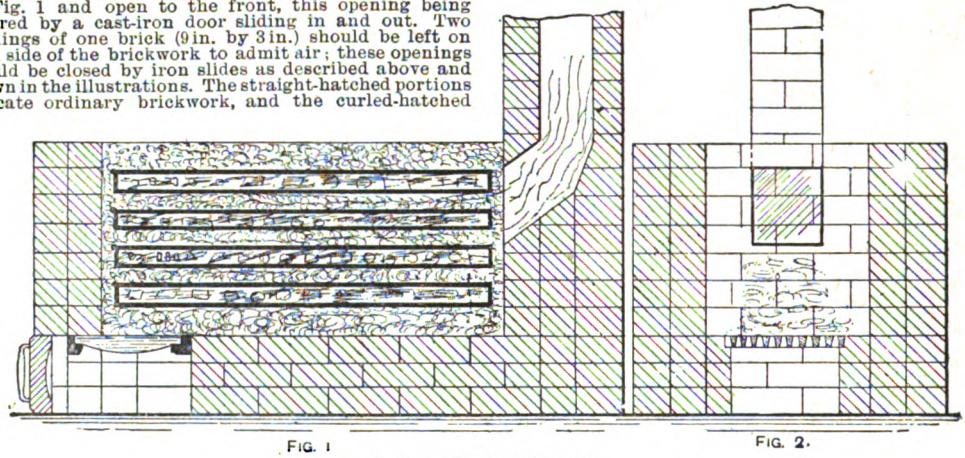


FIG. 1 FIG. 2.

Case-hardening Furnace.

portions the firebricks. The fire is started in the ordinary way, and when well alight is spread over the bottom and covered with new coke to the level of the first tray. The trays must be of good sheet iron. The hardening material, which consists of chips of leather burnt nearly black, forms in the tray a bottom layer on which the articles are placed. They are covered with the leather chips, and the tray is placed in the furnace and covered with a layer of coke. This operation is repeated until the furnace is filled up and covered with coke. When the fire is clear and white hot, the iron slides may be placed in the side holes and the whole furnace left to burn for from four to four and a half hours. The articles are then taken out and immersed, if of steel, in oil, or brewer's barm, or diluted tar. If the articles are of iron, they must be immersed in water. They will then be ready for polishing and finishing.

Aging Copper Plates.—To give copper finger-plates the appearance of old work, treat them as follows. Soak 4 oz. of liver of sulphur (potassium sulphide) for ten hours in 10 oz. of water. Clean the copper plates with soap and soda, and paint them with the solution. Relieve by scouring high parts of the ornament with pumice, sand, or Bath brick. Time will improve the appearance of the plates, especially if they are rubbed with a soft cloth or leather. To give a further appearance of age, leave the plates in a shallow box, covered with mould or earth which has been well moistened with vinegar. Then brush away the earth, etc.

Making Brewer's Yeast from Malt.—Brewer's yeast may be made from malt in the following way. Place 28 lb. of crushed malt in a tub, and pour upon it 5 gal. of hot water at a temperature of 160° F.; stir thoroughly, and after about half an hour strain off the liquid, and pour on the grains 2 gal. of water at 180° F. and treat similarly. Follow this by another 2 gal. of water, when practically the whole of the soluble ingredients will be dissolved out. Now mix the whole of the mashings together, place them in a shallow vessel, and when their temperature is about 70° F., stir in 1 pt. of fresh brewer's yeast, and allow it to ferment for from thirty-six to forty-eight hours; then skim the yeast off the surface of the liquid and collect it upon a fine hair sieve. The yeast will have increased very considerably in quantity, and the liquid from which it is taken will contain a considerable quantity of alcohol and should be utilised.

Triad Signboards.—A modification of the method of making triad pictures described in Series I., pp. 75 and 76, can be used in making signboards to give three different readings; for instance, tinsmith at the front, glazier at one side, and plumber at the other. In Fig. 10, p. 75 (Series I.), the board is divided into 1-in. and ¼-in. spaces alternately. On the narrow divisions wedge-shaped pieces with two 1-in. sides and ¼-in. base are glued or screwed from the back. Colour the ground of the flat spaces and uprights to the same shade, put one letter in each division, and the letters on the uprights will not greatly interfere with the view, especially if the spectator is at some distance from it. For larger boards, it would be as well to have 1½-in. and ½-in. divisions, with wedges of 1½-in. side and ½-in. base. Advertisements, pictures, etc., may also be painted on horizontal strips instead of perpendicular, then pasted on wooden laths, put into a special frame, and changed by turning a thumb handle, much on the principle of venetian blinds. If pasted on cardboard strips, strings take the place of the handle.

Ventilating a Photographic Dark Room.—If the dark room is an ordinary closet or cupboard in a house, a row of holes can be bored at the bottom of the door and another row of holes at the top of the door, and both sets of holes covered with boards louvre fashion so as to admit air but exclude rays of light. More definite instructions for ventilating a dark room cannot be given, the system depending on the position, etc., of the room. But certain general rules must be observed in order to make any scheme of ventilation effective. Hot air ascends to the top of the room, and means of exit must be provided for it at the highest available point. Inlets for cold air should be provided at the lowest available point, so that a free circulation of air may be set up in every part of the room. The inlet holes should be in such a position that any currents of air from door or window will strike against them, and the outlet holes should be sheltered from draughts so that hot air that seeks exit may not be forced back into the room. The protecting louvres referred to above should be so arranged as to spread the incoming current of cold air as much as possible, and to interfere as little as possible with the exit of the hot air. An ordinary dark-room lamp affords a very good illustration of the manner in which a dark room may be efficiently ventilated and extraneous light completely excluded. But even under the most favourable conditions the dark room, if it is a small closet or cupboard, soon becomes stuffy with foul air; when, therefore, a long spell of developing is in progress, the room should, about every half hour or so, be vacated for five minutes, and the door left wide open so as to change the air as much as possible.

Effect of Frost on Concrete.—There do not appear to be any data available for deciding at what temperature it becomes unsafe to lay concrete, but it is, as a general rule, not advisable to do any concrete work when the temperature is below freezing point; although good work has been constructed when the temperature in the middle of the day was 6° F. below freezing point, going down to 42° below freezing point in the night. The effect of the cold is to freeze the water before it has combined with the cement and to disintegrate the concrete. It must also be remembered that the setting of cement is a matter of chemical combination, and, like most other chemical combinations, is retarded by cold; consequently, even though the concrete be not actually frozen, its full strength will not be attained for a long time, and perhaps never. Tests of briquettes gauged and kept at ordinary temperatures, compared with briquettes exposed to temperatures varying from 41° to 22° F., show that the latter after seven days were 34 per cent. weaker in tensile strength than the former, although after twenty-eight days they were of the same strength. During frosty weather the addition of common salt to the water used in mixing the concrete will often allow the mixing of concrete and its after use to be carried on without detriment, because salt water freezes at a lower temperature than fresh water.

Groove Plane.—The groove plane shown in the accompanying illustrations may be made of any hard wood, but the blade is a ¼-in. chisel (see Fig. 1). The piece A (Figs. 1 and 2) replaces the skate-plate of the plough, B regulates the distance of the groove from the edge of the wood, C forms the fence, and D acts as a check to keep the blade

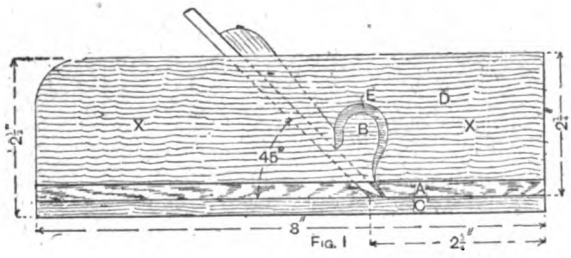


Fig. 1

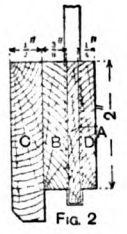


Fig. 2

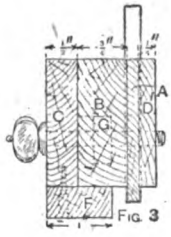


Fig. 3

Groove Plane.

and wedge in place. It will be seen that a little wood is taken out of B and D to admit the blade and wedge. The hollow E (Fig. 1) allows the shaving to come out. A sliding-fence would make the plane more useful. This may be a piece of wood with two slots, held in place by two set screws fixed in the sole of the plane or like Fig. 3. The pieces D, A, and B, are fastened together, and C and F form the sliding fence, G being a nut for the thumbscrew. Two screws would be required, their positions being marked by crosses in Fig. 1. To set the fence wider, slacken the thumbscrews and insert a piece of wood between C and B (Fig. 3) of the same width and length as B, and with two notches to pass over the bolts; then tighten up the screws. The fence is ¼-in. from the blade, therefore a piece of wood ¼ in. thick placed between C and B would make the fence ½ in. from the blade. The measurements given in the illustrations herewith may, of course, be varied to suit individual requirements.

Bronzing Copper.—Copper can be bronzed by simple immersion in a solution of 5 drachms of nitrate of iron to 1 pt. of water. A bronze similar to that on tea urns is produced by thoroughly cleaning the surface and coating it with a paste of crocus powder and water applied with a brush, and then holding it in a sheet of iron over a clear fire for about a minute. A deep bronze can be obtained by substituting finely powdered plumbago for the crocus. Rubbing the metal with a solution of potassium sulphide (liver of sulphur) produces, when the coat of solution is dry, the appearance of antique bronze.

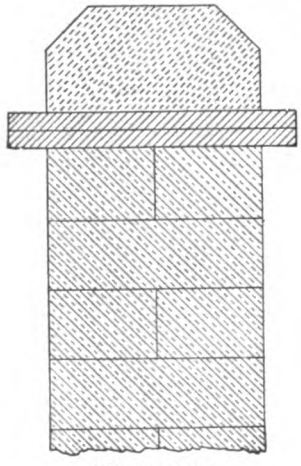
Speaking Tubes and Fittings.—In general, speaking tubes are composed of zinc, iron, or composition pipe. The last-named material, possessing flexibility, is chosen in many instances for the ease with which it can be run; it is easily bent to any shape required, an important consideration where there are many difficult corners to get round. Although this material probably deadens sound to a greater extent than zinc tube, it is likely in practice to carry the sound as far as, if not farther than, iron tubes. The care taken in running the tubes (whatever the material of which they are composed) will influence to a great extent the amount of clearness with which the sound will travel through them, as well as the effective length to which the tube may be run. Without doubt the chief consideration is to run the tubes in as direct a manner as possible from one point to another, but if, as is almost invariably the case, bends must be made, sharp angles should be avoided by easing the pipe round corners as much as possible. It is only reasonable that the sound must travel better if the tubes are not embedded in plastering more than can be helped. Other things being equal, the larger tubes carry the sound much farther than those of small diameter. Composition pipe is generally sold by the hundredweight, and about two coils would weigh 1 cwt. The weights per yard for the following diameters are, according to one list, ½ in. diameter, 1 lb. 10 oz.; ¾ in. diameter, 3¼ lb.; ⅞ in. diameter, 4 lb.; and 1 in. diameter, 5 lb. A very good size for ordinary use is ¾ in. diameter; larger sizes are more suitable for long lengths. Probably 40 yd. to 50 yd. is the maximum in favourable circumstances for ¾-in. pipe, but bends reduce this considerably. Zinc tubes, which can be had socketed for slip joints and in lengths of 7 ft. or 8 ft., are also to be had ¾ in., ¾ in., and 1 in. diameter, and with the requisite fittings such as round elbows, acute bends, obtuse and acute angles, etc. Zinc is not a good material to use if there is the least suspicion of damp, as probably it will be found after a time to be corroded. Wrought-iron tubes can also be had in all sizes, with any necessary connections. The mouthpieces are usually of cocus or ebony, as well as in ivory, but the cost of the latter is prohibitive in ordinary cases. The mouthpiece can be attached by means of an elbow to the tube direct, or it can have a terminal consisting of a length of flexible braided tube from 18 in. to 3 ft. long, with the mouthpiece attached at one end, the other being secured with an elbow or other fitting to the speaking tube proper. In this case a mouthpiece holder and rose are required to hold the terminal when not in use. The shape of the mouthpiece may be round or oval, to choice. There is a patent fitting to be had which has a tube for putting to the ear as well as a mouthpiece. This is a great advantage over the ordinary way of both listening and speaking by means of one mouthpiece. In selecting mouthpieces it is well to choose one with a good strong chain attached to the whistle, for if the whistle can become easily displaced it is liable to be lost and thus become a frequent source of annoyance to the user.

Mounting Photographs in Albums or Scrapbooks.—For mounting photographs in an album or scrapbook often the paper warps when the mountant is applied; and there does not appear to be any mountant that will completely overcome this fault, although innumerable preparations that claim to prevent warping or cockling have been put on the market. If a mountant is used containing water, a difference in stretching between the print and the mount is sure to occur. Hence the most satisfactory preparation is either an alcoholic solution of gelatine or a solution of india rubber. There is, with the former solution, considerable difficulty in getting the print to lie perfectly flat, even, and free from lumps and wrinkles; whilst the rubber is liable to perish, and then the photograph will peel off. On the whole, the gelatine solution is to be preferred, but it should be applied only to the extreme edges of the print. To do this neatly, lay the dry print face down on a sheet of glass and place over it a pad of stout paper that will give the print ¼ in. of free edge all round. A narrow edging of gelatine solution (which must be thin) may then be readily run round the exposed edge of the print. Lay the print correctly in position as quickly as possible, and press well into contact, but not hard enough to squeeze out the gelatine.

Making Ink Tablets.—Ink tablets are made in the following way. Extract 42 parts of Aleppo gall-nuts and 8 parts of Dutch madder with sufficient warm water. Filter the extract, dissolve in it 5½ parts of green vitriol, and add 2 parts of pyrolignite of iron and 1½ parts of indigo solution. Evaporate almost to dryness, and shape into tablets. For use, dissolve a portion of a tablet in hot water, when a good writing and copying ink will be obtained. The ink powders, recipes for which are given in Series I., p. 266, could be made into tablets by moistening with strong gum-water, shaping, and drying.

Boat Keel.—The amount of keel (lead ballast) to be carried by a boat is determined by subtracting the weight of crew and hull from the total displacement, the remainder being the weight available for ballast. The weight of the crew is determined by the designer, allowing, say, 144 lb. for each person; the weight of the hull has to be calculated by the designer item by item, and involves considerable labour. A formula giving a rough approximation to the weight is $\frac{L \times B \times D}{100} \times \cdot 2 =$ weight required in tons, L, B, and D being the length, breadth, and depth in feet respectively. This is for fairly light boats.

Tile Creasing.—Tile creasing is a projecting string-course formed of two courses of flat tiles; these are laid in cement, and break the joint. It is intended to serve as a weathering course so as to throw the rain water off the surface of a wall as shown in the sketch, and it is also of some value as an ornamental feature.

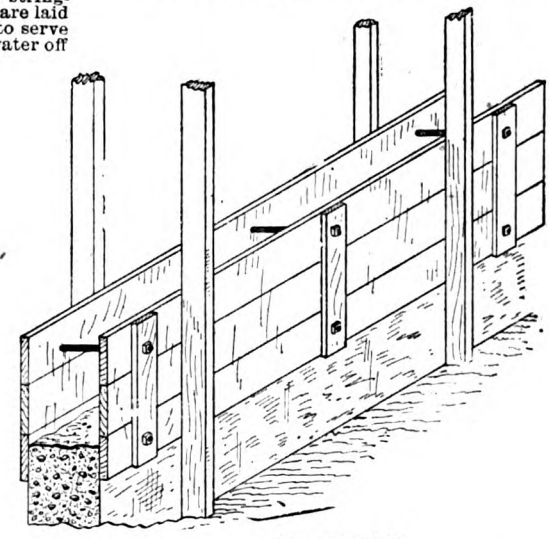


Tile Creasing.

Solder containing Phosphorus.—The proportions for one solder for aluminium are zinc 50·03 parts, tin 47·99 parts, aluminium 1·76 parts, and phosphorus ·22 parts. When adding the phosphorus, first mix it with the tin as follows. Take a length of 1-in. gas barrel which has a screwed cap at one end, the opposite end being closed with a tin plug. Remove the screwed cap, and, having carefully dried between blotting paper the proper proportion of phosphorus, insert the latter in the tube and replace the cap. Now put the plugged end of the tube into the molten tin; this will melt the plug of tin and so allow the phosphorus to come in contact with the molten metal. The ingot of phosphor-tin formed could be alloyed with the zinc and aluminium, or preferably with the zinc alone, leaving out the aluminium altogether. When using this solder, the phosphorus acts as a flux; consequently no other is necessary. Use an ordinary copper bit forged to a wedge shape and bent to form roughly a quarter circle. With such a bit, its wide edge is used at right angles to the surface of the aluminium, and by lightly moving it backwards and forwards when charged with solder, a clean aluminium surface is exposed, and to this the solder adheres.

Laundry Drying Room.—A laundry drying room is an apartment that is heated to a high temperature and is freely ventilated. The hot-water piping generally used is 80-ft. run of 3-in. pipe for every thousand cubic feet of space in the apartment. This quantity of pipe will raise the temperature to about 90° when the room is empty and dry. A larger quantity of piping is often used in order to expedite the drying. The ventilation of the room is a matter of the highest importance. Air can only hold a certain amount (very little) of moisture, hence the necessity for providing for the prompt removal of the moisture-laden air and replacing it with air that is warm and dry. If a drying room is not ventilated, it may be heated for many hours and yet not dry the clothes. Warm air is a quick drier if constantly renewed. Fresh-air inlets must be provided at places where the air will pass over the hot pipes, and there must be a chimney which by its draught will act as an extractor of damp air. The storing and packing room requires only 20 ft. of 3-in. pipe per thousand cubic feet of space. A small upright boiler (heated by coke) will be the cheapest heating arrangement. The fire will require feeding only once in about eight hours.

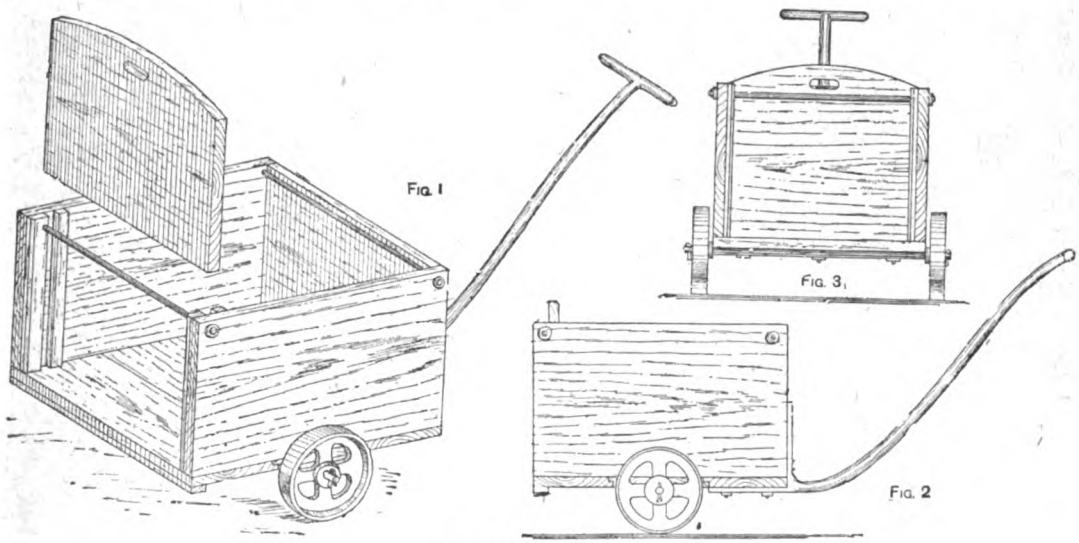
Concrete Wall.—Concrete walls may be formed of a mixture of 1 part by measure of Portland cement to 2 parts of clean sharp sand and 4 parts of gravel. As a preliminary measure, the amount of sand contained in the local gravel must be ascertained. To do this get a box of about, say, 1 cubic yard in capacity; the box should be measured, so that the number of cubic feet it holds may be accurately calculated. Fill the box with gravel, and then riddle the gravel to separate the sand. By measuring the sand, the proportion it bears to the gravel, as well as the extra sand that must be added, will be ascertained. According to the required proportions given above, there should be just half as much sand as there is of clean gravel. Take care that the sand is free from loam or earth. The illustration shows how the framing is arranged for building the wall. Uprights of say 3 in. square or any other convenient size are fixed along the inside and outside of the proposed line of wall. They will need shoring and bracing, as they have to serve as guides for sheet boarding. The boards are 1 in. thick made up in sheets of say 9 ft. long by 2 ft. deep, and clamped together. Iron bolts pass through the thickness of the wall near the top and bottom of the sheets. The concrete is filled in between the boards in layers of about 6 in. thick, and well punned. To make a good sound job the ramming should be attended to well. When one set of boards has been filled in, that part of the work is left to set and another length proceeded with. After a few hours, when the concrete has fairly set, the bolts may be knocked out and the sheets shifted a stage farther along between the next set of upright guides. The holes left by the bolts will require filling in. To prevent the concrete sticking to the bolts and the inside of the boards, smear both bolts and boards with soft soap. Do not let the concrete dry too quickly; if the weather is hot and bright, keep the concrete sprinkled with water and covered with wet sacks. Well wet the top of the old concrete when commencing a new layer, so as to ensure a good joint. For forming chimney flues in concrete, use a wooden core of 9 in. diameter, with a handle at the top for drawing it upwards as the concrete is built round it. Finished concrete buildings may be floated inside and out with 1 part Portland cement to 2 parts sharp sand.



Concrete Wall.

Photographic Exposure Meters.—A photographic exposure meter may be made by exposing a strip of carbon tissue in small squares, giving the portions increasing exposures, and converting the graduated scale thus obtained into a transparency. Transparency tissue should be used, and the exposure just timed to leave the last portion clear glass. Tissue or tracing paper may be cut in strips, each slightly shorter than the other, and superimposed. A gradation of light is secured in this way, but the most satisfactory plan is to use a sheet of thin metal, perforated with holes of such diameter that each one gives one-fifth more light than the next. In front of these is fixed a sheet of glass bearing numbers or letters of equal density, and against them may be placed the sensitive surface for testing; this is measured by the last number which is visible. For roughly timing carbon printing, a strip of P.O.P. may be exposed beneath a negative of proportionate density.

Small Coal Barrow.—Figs. 1, 2, and 3 show a useful form of coal-yard barrow suitable for use by children in fetching coal. The body of the barrow is of wood about 1 in. thick, the two sides, one end, and the bottom being firmly nailed together, and further strengthened with iron rods about ¼ in. diameter that pass through the barrow and are riveted over a washer at each end as shown in the illustrations. The back of the barrow is made so as to slide in a groove, which is formed by nailing on fillets of wood as shown. The axle is of the simplest form, a piece of iron about ⅝ in. by 1¼ in. being forged with a collar at each end, the ends being rounded to receive the wheels, and having also holes for linch pins. The axle should be perforated with three or four holes so that it can be fastened to the bottom of the barrow with bolts and nuts. The wheels may be of iron, and may be bought ready made, or they may be made of wood and fitted with an iron tyre. Wooden wheels should be bushed with an iron eye, in which the axle is to turn. The handle should be of round iron about ¾-in. diameter of the shape shown in the illustrations, and fastened with bolts. Good red deal will be suitable for the barrow, but oak, elm, or other similar hard wood may be used. A useful size for the barrow would be 1ft. 9in. long, 1ft. 4in. wide, and 1ft. deep; no doubt it would be necessary to have some smaller and some larger.



Small Coal Barrow.

Pill-making Machines.—The simplest form of pill-making machine consists of two thick brass plates 9 in. to 12 in. long, in which are hollowed several V-shaped depressions, the depth of these being equal to half the diameter of the pills to be made; the depressions are close together so that their edges are sharp. One of the brass plates is screwed to a bench; the other is mounted on a board provided with four wheels, and is so arranged that it runs across the first plate with the depressions at right angles. The pill mass is made up in the usual way, and is rolled out into thin rods which are cut to the size of the brass plates; these cylinders are placed in the grooves in the bench plate, and the movable plate is then run across it, thus half severing the pill mass into equal lengths; the rods are then cut right through with the tip of a small spatula. The unformed pills are placed in a cylindrical tinplate box with a quantity of finely powdered sugar or French chalk, and the box is shaken or rotated quickly until the pills are of the required shape. Several machines are used for pill-making: the mixing machine, pipe-making, cutting, rounding, and coating machines.

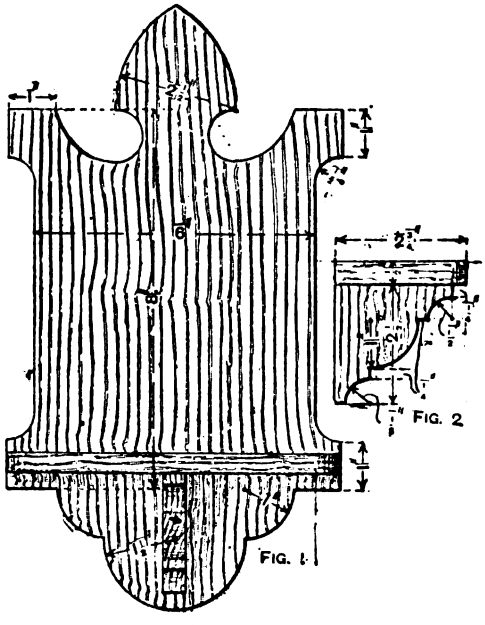
Laundry Blue.—Cake laundry blue may be ultramarine, bound together with starch or gum; sometimes other blues, such as indigo, soluble Prussian, and Berlin blue, are substituted for the ultramarine, but the latter is the best blueing agent, and the continued use of Prussian blue will give linen a yellowish tint. The ultramarine should be strained through a fine cloth before use. As a rule, it is not necessary to adhere to any fixed proportions in making laundry blue, but the following recipes have been formulated and probably give better results than any haphazard mixing of the ingredients. (1) Moisten with water a mixture of 2 parts by weight of ultramarine and 1 part of starch to make it flaky, but not pasty, and then press to shape. If the blue crumbles on pressing, add gum arabic or dextrine to the water. (2) Mix into a paste with water, 6 parts by weight of ultramarine, 4 parts of sodium carbonate, and 1 part of glucose. Press to shape and allow to dry. (3) Mix 3 parts by weight of indigo, 1 part of starch, and a trace of gum arabic to a stiff paste with water, press to shape, and allow to dry. (4) For a disinfecting blue, mix into a stiff paste 16 parts of Prussian blue, 2 parts of commercial carbolic acid, 1 part of borax, and 1 part of gum arabic; roll into balls, and coat with gelatine or gum to prevent the carbolic acid from escaping. Liquid laundry blues may be made as follows. (1) Bottle 1 oz. of powdered Prussian blue with 1 qt. of water and add ½ oz. of oxalic acid. A teaspoonful is sufficient for a large quantity of washing. (2) Make a solution of aniline blue in cold water. (3) Dissolve Prussian or Berlin blue in water, and add just a trace of ferrocyanide of potassium. (4) Dissolve 2 parts of indigo-carmine in 20 parts of water and add 1 part of gum arabic. (5) For Liefchild's liquid blue, add gradually boiling water to a mixture of 4 parts of Chinese blue, 1 part of Turnbull's blue, and 1 part of oxalic acid, until the mixture dissolves, and then add 4 parts of indigo sulphate.

Gilt-work Tarnishing.—The tarnishing of recently gilded surfaces is due either to bad size or to applying the gold leaf before the size was in a proper condition to receive it. If japanner's gold size has been used, the size was bad; if oil size has been used, the size was not in a proper state of tackiness when the gold leaf was applied. The application of varnish to the tarnished gilding would make matters worse: gilded work should never be varnished. The work must be re-gilt: coat with knotting, and when this is dry, apply old oil gold size costing about 4s. per lb. When the size is in a proper state of tackiness, apply the gold leaf.

Re-polishing a Violoncello.—If the varnish of a violoncello is much worn, it will be necessary to remove it, leaving the wood perfectly clean before re-polishing; if the varnish is sound, the surface may be cleaned by warm water and pumice-stone soap, and freshened up by using white or transparent French polish, which is applied by a pad. The application of a thin, even coat of brown hard spirit varnish laid on with a camel-hair brush would greatly improve the surface after the cleansing process.

Concrete Roof Leaking.—If a flat concrete roof cracks and leaks owing to the influence of the sun, the whole of it should be covered with a ¼-in. or ½-in. thickness of natural asphalt—not a mixture of pitch and tar, but the natural bitumen. This is sufficiently elastic to expand with heat and contract again without developing cracks. If this is too expensive, try filling in the cracks with asphalt and then covering the roof with 3in. or 4in. of earth to protect the concrete from the heat of the sun.

Wall Bracket.—Fig. 1 is the front elevation of a small wall bracket which may be of ¾-in. or ½-in. wood. A hole might be made in the back to take a small oval mirror.



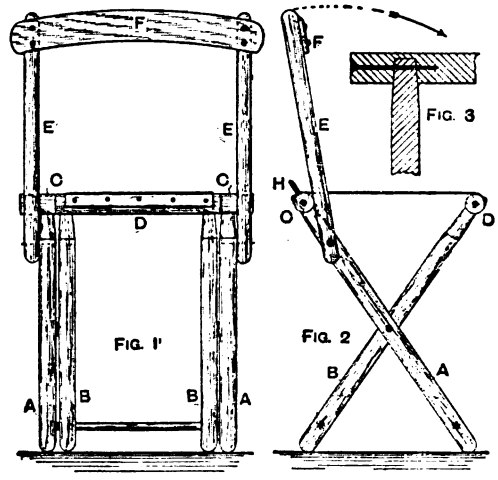
Wall Bracket.

The ends of the shelf are rounded. Fig. 2 shows the shape of the support and the end of the shelf. Two screw eyes by which to hang the bracket are inserted in the top corners.

Extracting Oil from Eucalyptus Leaves.—Oil is extracted from the leaves of the eucalyptus tree by boiling the leaves in water; on distilling, the oil passes over with the water. The terpene of eucalyptus oil has a definite boiling point; therefore to purify it from other materials heat it in a small still in which the temperature is not allowed to rise above that required. The pure oil passes over into the receiver, and the impurities are left behind in the still.

Gilding Book Covers.—The gilding of letters, etc., on the covers of books, or gold-tooling, as it is called, is accomplished by tools heated on the plate of a gas stove; and lying on the bench conveniently is a little heap of cotton waste saturated with water, called a cooler. Against this the tools are pressed and cooled down as required, and the proper heat is judged by the noise or fizz that the tool makes on the water; this can only be determined by experience. It will be better at first to use the tools too cold rather than too hot, and if the gold leaf does not stick the tool can be used again, but hotter, until the work is accomplished and the experience gained. Different materials, such as cloth, and leather of various kinds, require different degrees of heat. Roughly, however, the tools should in no case be hotter than can be grasped by the fingers and held for an appreciable amount of time. Glaire is used for making gold leaf adhere. Glaire is prepared by breaking an egg and allowing only the white to fall into a small vessel. Beat this up until the whole is in a thick froth—short and crisp, with no trace of stringiness in it—and allow to settle down into a clear amber coloured liquid which will improve with age; a drop of vinegar will help to keep it sweet. The part to be gilded is coated with the glaire and allowed to become dry. The gold then is laid on, and the hot tools applied with pressure, more or less according to the size of the tool or the materials under the hand. Beginners are advised to practise on some waste material before attempting book covers.

Folding Camp Chair.—Figs. 1 and 2 show front and side elevations of a folding camp chair. The legs A are 1in. in diameter, and joined by a stiffener ½in. in diameter and 11½ in. long, let in about 2in. from the bottom. The legs B, also 1in. in diameter, are joined in a similar manner by a rod 9in. long. The second frame is pivoted inside the first frame, the two being separated by small washers. The tops of the legs are tapered to fit holes in the two seat rails C and D, 1½ in. in diameter, and secured by means of glue and by a nail driven in from the ends as shown in Fig. 3. The rail C (Figs. 1 and 2) is 1ft. 3in. long, while D is 10½ in. long,



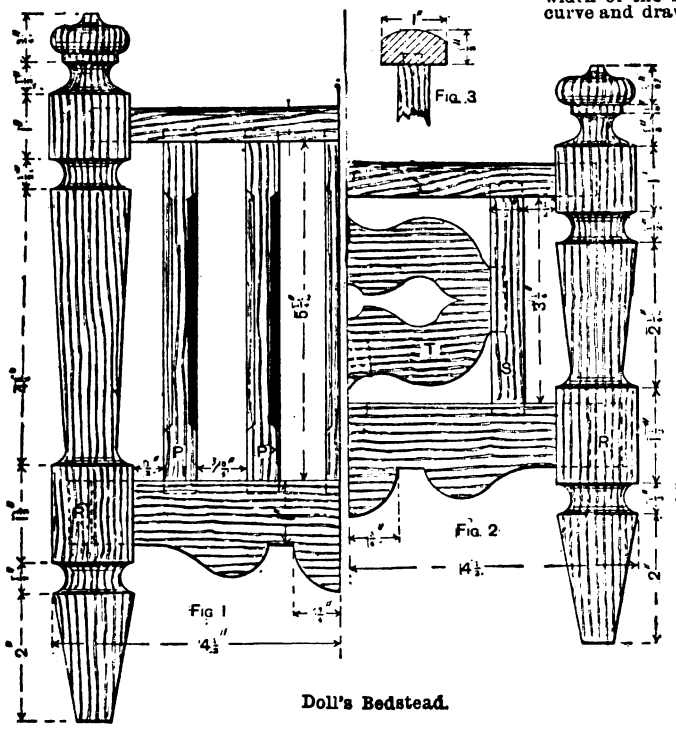
Folding Camp Chair.

both being joined by a strip of canvas about 9½ in. wide. The back consists of two pieces E, ¾ in. in diameter and 1ft. 4in. long, joined together by strip F, 2in. wide, ¾ in. thick, and 1ft. 3in. long. This strip is curved upward as shown, and is hollowed in the centre for comfort. When not in use the frames A and B lie flat against each other, and the back E swings down in the direction indicated, so that by means of a leather handle at H the whole can be easily carried from place to place.

Making Bell-mouthed Piece in Sheet Metal.—The bell mouth of a phonograph trumpet may be worked to the desired shape from a flat disc of metal. Cut a disc of a diameter equal to that required for the larger end of the mouth, and also cut a small circle from the centre. Now work round the edge of the inner circle with a stretching hammer until the metal is partly raised, and then place it upon a mandrel of suitable size, and work the stuff from a circle drawn midway between the inner and outer ones, towards the centre. Work over the metal with the same hammer as before, but with blows delivered parallel to the edges of the disc, commencing at the line mentioned above, and working round and in to the smaller circle until the edge is reached. Frequently anneal the metal. Repeat the working until the desired depth is attained. The metal is then thoroughly cleaned, and the whole of the surface is again worked over. For this use a bright round-faced hammer upon a bright tool, the blows being delivered with the utmost regularity, until the surface is rendered quite smooth. Another way of making the bell mouth would be to spin it in a lathe, and in each case frequent annealing of the metal is necessary to ensure success.

Relief Stamp Gilding and Illumination.—The illuminating and gilding of relief stamps is accomplished in much the same way as ordinary relief stamping, the only difference being that for each colour or mass of gold a different die is required and a separate impression is made. That is to say, that a monogram or crest when complete may be composed of half a dozen dies, and each die may be of a separate colour which would have had a separate impression. The whole, when finished, would be a monogram or crest in six colours.

Doll's Bedstead.—Fig. 1 is the elevation of half of the head of a doll's bed, and Fig. 2 shows half of the foot, alternative designs being given for the filling between the posts. The pillars for the head are 11in. high by 1¼ in. square, and the feet are 9 in. high by 1¼ in. square; they are shaped with saw, gouge, chisel, and file, and viewed from every side are of the shape shown. The top and bottom rails are mortised into the pillars, the thickness of the rails being 1 in. The side rails are 1 in. square and are mortised into the pillars R (Figs. 1 and 2). The



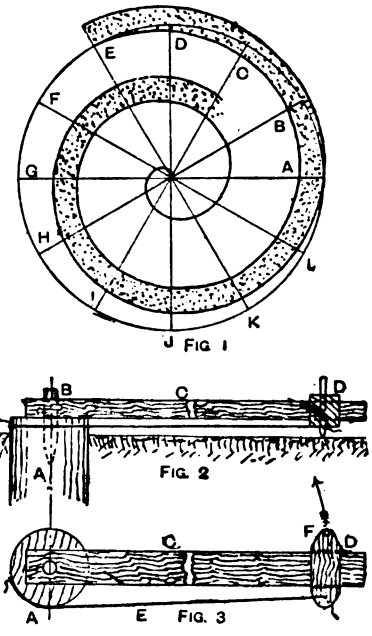
Doll's Bedstead.

bottom of the bedstead may be railed or corded, or plain wood may be sunk flush with the top of the rails. The pillars P (Fig. 1) are ½ in. square and stop-chamfered; S (Fig. 2) is ½ in. by ¾ in., and T is sawn out of ¾-in. stuff. The length of the bedstead will depend on the requirements. Canary wood, enamelled pale blue, may be used for the construction of the bedstead. Fig. 3 is a section of the top rail of the head (Fig. 1) and shows the tenoning of P. For those who possess a lathe, turned pillars might be more suitable, but square pillars, though taking more time to make, are less common.

Enamelling Photographs.—To enamel an albumen print a sheet of patent plate is first cleaned and polished with French chalk, then coated with Mawson & Swan's enamel collodion and washed till the plate is no longer greasy. Any necessary spotting or working up that the print requires must be done with oil colours, as ordinary spotting paint would be dissolved in the subsequent operations. Soak the print in water 10 oz., gelatine 200 gr., and either bring it in contact with the glass under the surface of the water or lay the print whilst still very wet on the glass. Cover with a sheet of blotting paper and stroke firmly with a flat squeegee, forcing out all air bubbles. When it is dry, a penknife may be inserted under one corner and the print will peel off, bringing with it the collodion film, the surface of which will have a most brilliant polish.

P.O.P. can be glazed in the same manner, but the collodionising and gelatine solution may be omitted. Some workers prefer to use, instead of French chalk, beeswax dissolved in turpentine or benzole, and it answers well. This mixture may also be smeared on the warm glass and polished over with a piece of flannel. Before the print is dry enough to leave the glass a piece of waterproof backing paper should be mounted over it. The two leave the glass together, and this backing paper to some extent prevents loss of glaze in mounting.

Setting Out Archimedean Spiral for Flower Bed.—In planting a circular bed with plants in the form of an archimedean spiral of three revolutions, the spiral may be set out as follows. Divide the circle into a number of equal parts as A to L (Fig. 1) and draw radii as shown. Divide one of the radii into three times the number of parts by which the circumference is divided. Now, starting the curve from the centre, on B mark one of the divisions of the radius, on C two, on D three, on E four, and so on, until the outside is reached; then trace the curve through the points. Mark the width of the bed either on the inside or outside of the curve and draw a parallel line which would enclose the



Setting Out Archimedean Spiral for Flower Bed.

spotted portion (Fig. 1). A spiral that would perhaps be suitable for the particular purpose mentioned above may be drawn as follows. In the centre of the bed fix a cylinder of wood A (Figs. 2 and 3) with a circumference equal to one-third of the radius of the large circle. Drive a spike B into the centre of the cylinder and take a parallel piece of wood C, in which bore a hole to fit on the spike B. Mortise a block of wood D (Figs. 2 and 3) to slide on C; then connect the back of the block by a cord E (Fig. 3) to the cylinder. Place a marking point at F and revolve the wooden arm. The string, kept tight, winds on the cylinder and draws in the block, causing the point F to describe the spiral.

Dressing Fishing Lines.—A recipe for a preparation for waterproofing fishing lines is the following. Dissolve sufficient sugar of lead in warm water to give it the appearance of milk. Soak the line in this and allow it to dry. Now well mix together in a gallipot equal quantities of boiled oil and gold size; coil the line and place it in the liquid, and after it has soaked for an hour or so, take hold of one end and draw it out through a piece of rag held between the finger and thumb of the left hand to wipe off superfluous dressing; then stretch the line and allow it to dry thoroughly. Or instead of gold size copal varnish may be used. This makes a better waterproof dressing but takes a long time to dry.

Bending Small Tubes.—In bending small tubes the operation of filling them with molten metal has many difficulties, particularly in the case of tubes of very small bore. For the latter it is a good plan to have available several different gauges of lead-wire, and when a tube is to be bent to insert one in it of sufficient size to prevent the formation of constrictions during the bending processes. Then after bending, if the wire cannot be drawn out owing to curves, it can, of course, be melted out in the ordinary way. Another, and perhaps better, method is to use a bundle of fine lead-wires drawn into the tube by means of a single stouter wire "burnt" on their ends. This will serve especially for superior work, as if the wires are not tangled, and if they are well oiled, they may often be withdrawn one by one, notwithstanding that several turns are in a tube, thus avoiding the risk of heat spoiling the tube. (See also Series I., pp. 14, 276, and 316.)

Spring Mattress.—A very satisfactory spring mattress can be constructed of two rectangular wood frames, these being made of clean pine 3 in. wide by ⅝ in. thick. Between these frames are fixed, at equal distances apart, about three dozen 8-in. hard springs; these are secured with spring staples. In order that the frames may work straight and parallel, all the springs round the four sides have a cone-shaped turned wood guide block A (Fig. 1) fixed to the rails by screws and working inside the spiral springs; these are fixed as in Fig. 2, so that these turned blocks A are alternately at the top and

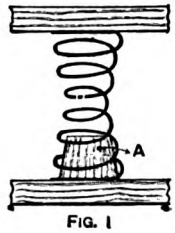


FIG. 1

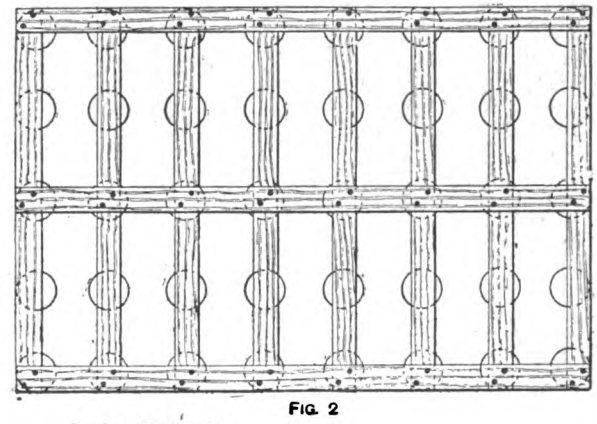


FIG. 2

Spring Mattress.

bottom. Many of these mattresses are covered directly as they are with striped ticking on the top and bottom and with fancy belgian on the edges, a tufted flock mattress taking the place of the upholstered top. To upholster the top, first web the spaces with grey webbing, cover the edges with hessian, loop the edges with twine, and pack with stuffing; then pick on the surface a good layer of flock or hair; cover this with scrym, space, and stitch down the tufts and stitch up the edges; then cover with coloured ticking, which should be bound at the edges with coloured mattress ribbon. Finish the top with red woollen tufts.

Bronzing Copper.—A bronzing solution for copper may be made by dissolving in vinegar 2 parts of verdigris to 1 part of sal-ammoniac, the solution being heated and diluted with water until there is no precipitate visible. The copper should be thoroughly cleaned and rendered free from grease, and the article then is immersed in the above boiling solution, and afterwards rinsed in cold water and dried in sawdust. This process is repeated until the surface is of equal colour and the desired tint is obtained.

Setting Out a Cant Board.—The general principle of a vehicle cant board is that it is a true chart of the plan of the body, from which all the widths at any point and the position of the various parts for framing together may be obtained. Each body of a distinct pattern requires a cant of its own, the same points applying in most cases in the marking out of such. Having been supplied with a drawing of the proposed body, with the necessary widths, etc., and the turn-under required, procure a thoroughly dry yellow pine board, free from shakes, 16 in. to 17 in. wide and 8 ft. to 10 ft. long, shoot one edge straight and square, then mark a line parallel with this edge 9 in. in; this will represent a 3-ft. line throughout the body, from which all measurements in width are taken. Then square off on the cant board the various points of the body. In a landau these would be: back of hind elbow, across hind and front standing pillars, front of front elbow, heel of bracket, and tip of the same. At these points the various widths of the body are marked in from the 3-ft. line. Thus, if a landau is 3 ft. 4 in. across the elbows and 4 ft. 2 in. across the standing pillars, the marks at the latter places will be 5 in. farther from the 3-ft. line than at the elbows; these points, when formed into a true sweep, form the base line of the body. At the standing pillars mark in the turn-under at the bottom-side; this can be obtained from the standing pillar pattern. Draw a true sweep from these points to the base line sweep at the elbows; this will give the turn-under line, which is the correct sweep around the bottom-side mouldings of the body; then mark in the thickness of the bottom-sides at the standing pillars and at the elbows. Draw lines from these points, also the contraction line for framing-in the bottom-sides, to be obtained from the standing pillar pattern; then the thickness of the rocker, which will give the line for the taper, to get the necessary throw-round of the bottom-side. At the front elbow the boot side is marked in the desired distance from the base line, then the width is marked at the heel of the bracket, which may be 2 ft. 6 in.; this point would be the opposite side of the 3-ft. line, 12 in. from the edge of the board. From the inside of the front elbow draw a straight line to the heel of the bracket; this will give the contraction of the boot-side; continue the line to the tip of the bracket, when the width can be got at that point; mark in the width of the bracket back to the arch, then the filling-up piece to carry the edge-plate on to the boot-side, from thence on to the rocker. To obtain the correct bevel on the front pillar of a landau or brougham, hold a wax line on the base line at the inner edge of the hind standing pillar, then mark across from the base line at the inside edge of the front pillar as far as the rocker line; this will also show how much the front pillar gathers towards the bottom of the doorway, owing to the bevel and turn-under of the body. To make the cant complete, all bottom cross-bars should be shown, also the edge-plates and flaps of the same.

Preserving Butter.—The only satisfactory way of preserving butter for any lengthened period is by keeping it in a refrigerator. The old method was to mix the butter with salt and pack it in a large earthenware jar, covered with a lid; butter will keep for several months in this way, though the taste gradually deteriorates, and it is very salt. Butter properly salted can be preserved for a considerable time in a jar with an air-tight cover. When the butter is required for use, it should be washed in changes of cold fresh water till the salt is removed. A pinch of cane castor sugar worked in gives it the sweetness of butter freshly made.

Ruddle.—Ruddle should be obtainable ready mixed for use as a paint. Ruddle is a red earth, coloured by sesquioxide of iron, and should be mixed as described below. Grind some red ochre thoroughly on the paint stone or in the paint mill with turpentine; then add a little patent driers and linseed oil so that the mixture will dry in a reasonable time. If a gloss is required, a good proportion of varnish should be added to the last coat of paint.

Wooden Frame Aquarium.—An aquarium about 6ft. long, 1ft. 2in. wide, and 1ft. deep is best constructed in teak, great strength being required. The bottom of the aquarium (Fig. 1) should be formed of 1-in. board, sufficiently wide to allow for the moulding which projects on both sides and ends. This moulding is shown at Fig. 2. The posts should be about 2in. by 2in., and of the shape shown at Fig. 4, where it will be seen that the inner edge is rebated. The bottom ends are tenoned into the bottom board; this joint is shown at Fig. 2. The upper rails, which are 2in. by 1¼ in., are fixed to the posts by means of mortise-and-tenon joints (see Fig. 3). The lower rails, which are 1¼ in. square, are nailed or screwed to the bottom. A muntin, 2in. by 1¼ in., is fitted in between the upper and lower rails on both sides: these must be rebated to receive the glass. All the joints of the woodwork should be put together with the same cement as is used for fixing the glass, and the mortises and tenons should be secured together with wooden pins or brass screws. The glass is held in position in the posts by means of a fillet A (Fig. 4), being screwed on after the glass is inserted in the rebates. For fixing the glass, use red lead and white lead mixed with a little gold size. The edges of the glass should be previously coated with gold size so as to make the

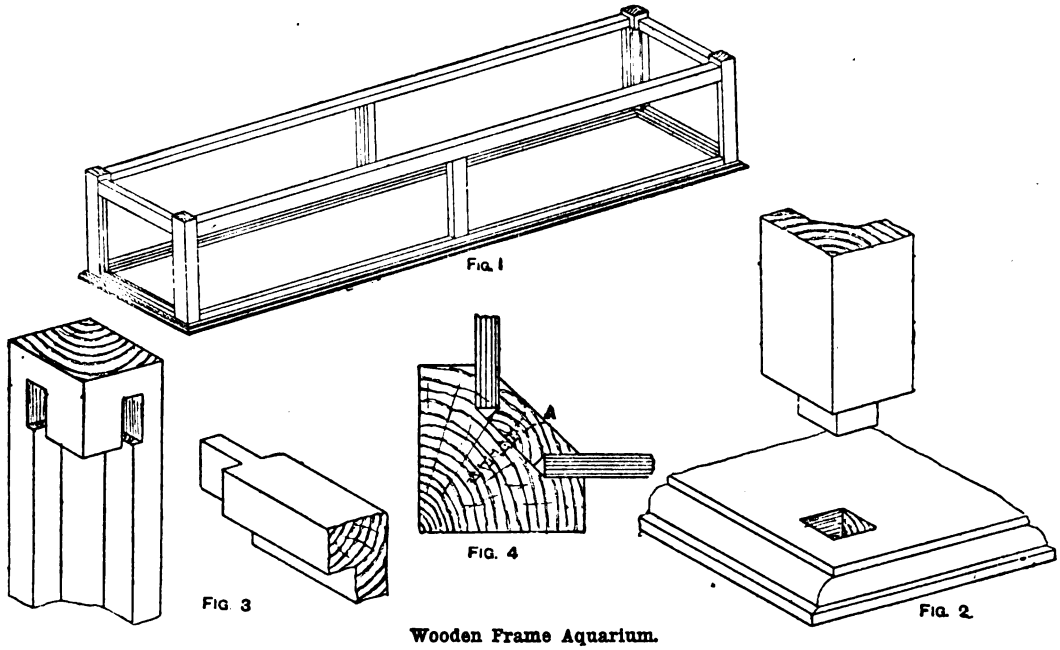


FIG. 1

FIG. 3

FIG. 4

FIG. 2

Wooden Frame Aquarium.

cement adhere better; only sufficient cement should be used to make a firm joint. Remove superfluous cement before screwing in the fillet A, Fig. 4. Plate glass ⅜in. or ½in. thick will be most suitable for the sides and for the bottom. The woodwork should be given two or three coats of enamel paint.

Testing Portland Cement.—It is not possible to test the quality of Portland cement without mechanical aids of some kind; a good deal of information, however, as to the quality of cement may be obtained without the help of any very expensive apparatus. The fineness of the cement, for example, can be measured with a sieve of the proper mesh and a small chemical balance; a very usual specification for fineness is that not more than 10 per cent. of residue shall be left on a mesh of 2,500 to the square inch. The specific gravity of cement should be from 3 to 3·17, and can be found by the ordinary specific gravity bottle and beam scales, as described in most text-books of physics (Ganot, for example). More roughly, the specific gravity of cement may be ascertained by testing it with a glass tube graduated to, say, 100 c.c., which is equivalent to 100 grammes of water. By filling the tube to the 100 c.c. mark with the powdered cement, shaking it down as much as possible, then pouring it into the scale and weighing it, the relative weights of the cement and the water will be obtained, though it is obvious that by this method the specific gravity of the cement will appear to be less than it really is, because of the air-spaces between the particles of cement. The texture of the cement when rubbed between the finger and thumb should be smooth and silky, with no grittiness. A blue-grey colour indicates that the cement is well burnt and slow-setting; cement of a browner colour is more likely to be quicker setting and weaker in ultimate strength; but too much stress should not be laid on these indications. The late Mr. Henry Faija, an eminent authority on Portland cement, expressed the opinion that if a cement is sound it is almost invariably strong enough for any work in which it may be used, and he devised the following test for soundness. Of the cement to be tested, sufficient to form a small slab, say ¼in. thick, is to be mixed with a minimum of water on a glass surface and at once subjected to a moist heat of 100° F. until the cement sets. The slab of cement must then be placed in warm water (which should be kept at 115°) for the remainder of the twenty-four hours. This is naturally rather a tedious process for ordinary cement users, and the following less troublesome test, though not so reliable, is more commonly used. A slab of cement, 2in. or 3in. in diameter and ¼in. thick, is mixed on a glass surface, allowed to set, and then kept for seven days under water of ordinary temperature. If no cracks develop round the edges of the slab, the cement may be assumed to be sound. On the other hand, failure to satisfy this test may be due to the fact that the cement is too new and not sufficiently aerated. A thin glass bottle may be filled with semi-liquid cement and put aside till the cement has set. If in a few days the expansion of the cement causes the bottle to burst, this is an indication that the cement is not sound. Tests for tensile strength are made on special machines, and it is these tests that are mostly relied on. Instead of the tensile strength, the transverse strength of a bar of cement may be taken as a guide. The test can be carried out without much trouble in the following manner. Make a wooden mould in which bars of cement, 20in. long by 1in. by 1in., may be cast, the mould being constructed so as to open and allow of the bars being removed without breaking them. Now, from a cement that is known to be good, and equal to the specification that has to be worked to, mould some half dozen or a dozen bars, the water used in mixing the cement being measured so that the same quantity of water may be used in testing other samples of cement. The standard bars are then kept under water for seven days. The bars are then supported on iron knife-edges, say 18in. apart, and are loaded in the centre with known weights until fracture occurs. The results thus obtained will serve as a guide in testing the strength of any other cement that has to fulfil the requirements of the same specification as the standard cement.

Cleaning Leather Breeches.—If the breeches are tan coloured, mix together equal parts of yellow ochre, brown umber, and light carbonate of magnesia; incorporate these with petroleum ether to form a thin paste. Lay the breeches on a table, and brush them well with the above preparation, which should be laid on plentifully. Now hang the breeches in the open air to dry, and brush out all the powder with a stiff brush. Finish by rubbing with yolk of egg or brown boot polish, applied on a rag. A solution of oxalic acid is also used for cleaning.

Large Wooden Cistern.—Figs. 1, 2, and 3 show respectively a side elevation, plan, and end view of a cistern, which may be 12 ft. long, 5 ft. broad, and 3 ft. deep. Fig. 4 is a part section of the ploughed and tongued joint of boards, fillet, ledger, and packing pieces A. Fig. 5 is an isometric view of a portion of one corner. The wood used in the construction of the cistern should be at least 2 in. thick. The boards should be jointed and ploughed and tongued together, as shown. The plough groove should be nearer the inside, so as to leave more wood outside to which to nail the fillets. For the sides 9-in. boards may be used, but for the bottom narrow widths (say 4½ in.) will be more suitable. All the joints should be ploughed and tongued and put together with a mixture of white and red lead. The ends should be housed into the sides as shown at Figs. 1 and 5. As a further security against the joints leaking, on the outside fillets about 2 in. by 1 in.

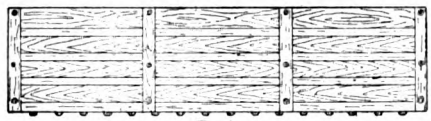


Fig. 1

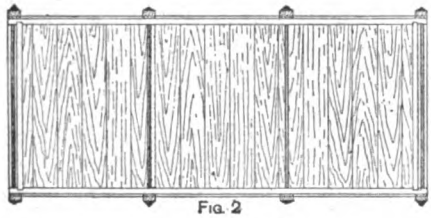


Fig. 2

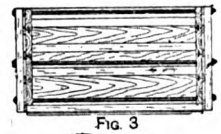


Fig. 3

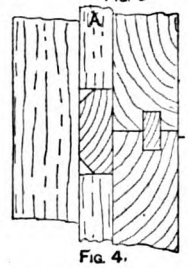


Fig. 4.

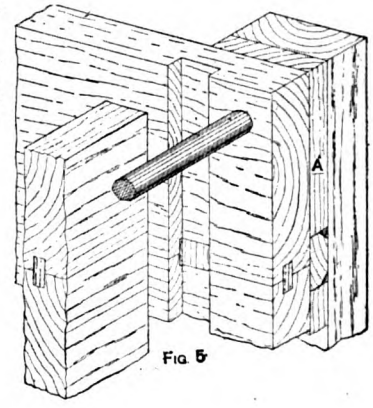


Fig. 5

Wooden Cistern.

should be bedded with white and red lead, and then nailed on as shown in the illustrations. The sides, ends, and bottom must be firmly nailed to each other and further strengthened on the outside by ledgers and ¾-in. bolts, as shown; the bolts passing through the cistern should be of galvanised iron. The outside of the cistern should be given a coat of tar.

Glaze used by French Polishers.—French polishers' glaze is usually made by steeping 6 oz. or 8 oz. of gum benzoin in each pint of methylated spirit used. This gum readily dissolves in hot or cold spirit. If gum arabic, gum mastic, gum copal, or other tough gum is added, it is a common practice to add a quantity of powdered glass with the object of cutting the gums when the mixture is stirred up or agitated; it forms no part of the glaze itself, and needs very careful straining to avoid getting any on the polished surface.

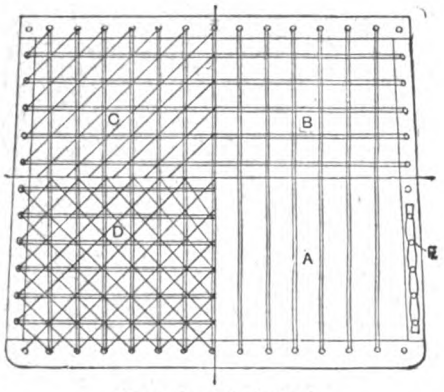
Brassing Small Iron Goods.—The brassing of small bright iron-wire articles can be done only by deposition. A brassing bath will be needed, the following being suitable for cold working. Carbonate of copper and carbonate of zinc recently prepared, of each 4 oz.; carbonate of soda in crystals, bisulphite of soda, and pure cyanide of potassium, of each 8 oz.; ½ oz. of white arsenic; and about 2 gal. of water. Dissolve in 3 pt. of water 5 oz. of copper and 5 oz. of crystallised sulphate of zinc, and add a solution of 14 oz. of carbonate of soda in 1 qt. of water. A greenish precipitate of carbonates of copper and zinc is formed; this must be well stirred and allowed to settle for several hours. Pour off the water, and replace by nearly 2 gal. of fresh water, in which are dissolved the bisulphite and carbonate. Dissolve in the remaining warm water the cyanide of potassium and the white arsenic, and pour this liquid into the other, which becomes rapidly decolorised and forms the brass bath. The vats for cold platings usually are guttapercha-lined wooden tanks, the sides of which are also lined with brass sheets, joined together and thus connected with the carbon or copper of the battery. The articles to be brassed are suspended by copper or brass hooks to stout rods of the same metal, and thus connected with the last zinc of the battery. The intensity of the batteries is regulated by the surface of the material to be brassed. The losses of the solution will need to be made up from time to time by the addition of copper and zinc salts dissolved in cyanide of potassium with the arsenic. A bath for giving small iron or steel articles a brassy look by long stirring consists of a solution in 1 qt. of water of ¼ oz. each of sulphate of copper and protochloride of tin.

Making Tilt for Cart.—If the tilt on a small cart is to be a permanent fixture, the hoopsticks should be halved into two rails fixed on the top of the body, level with the outside, 3-in. battens being screwed on at intervals outside the hoopsticks to keep them rigid. The cart could then be covered with a prepared japanned canvas, which requires no painting after being put on. For a portable cover the hoopsticks should be made to slide into small iron sockets or staples fixed on the outside of the body, two for each end of a hoopstick, so as to keep the latter firm, the front and hind staples being fixed at such an angle as to give the necessary pitch to the ends of the tilt. The hoopsticks should be of ash, 1¼ in. wide by ⅝ in. thick, and when ordering, the width of the cart outside the top rail should be given as the inside width of the hoopstick. To prevent the hoopsticks slipping too far down when put into place, a small rose-headed screw is turned in on the outside, directly over the top staple. The sticks should be covered with double texture waterproof sheeting, which may be obtained 60 in. wide. To get the length required, put a tape over the hoopstick from side to side, allowing 3 in. for turning at the bottom edges. These edges, and also the front ones, should be well pressed back, and fixed down with rubber solution. To fasten the cover on the body, brass eyelets may be let into the bottom seams, and studs fixed in the body. Or small leather straps may be fixed along each edge.

Coating Terra-cotta with Copper.—So that copper can be electro-deposited on terra-cotta, earthenware, etc., the surface of these materials must be first rendered conductive to electricity. This is done by coating with blacklead, bronze powder, or some other finely divided metal. Blacklead is brushed into the pores of the material in a dry condition until the whole surface is evenly coated and well polished. Bronze powders are mixed with methylated spirit and applied in the form of a paste. If the surface is briskly brushed with a new brass-wire brush, it will become coated with brass and thus made conductive. A copper wire must then be tightly twisted around some part of the article and connected to the conductive surface by a liberal application of the powder. Thus prepared, the article is immersed in an electrotype solution, connected to a battery or dynamo, and copper deposited in the usual manner. Only a very thin coat must be applied if the pattern is to be retained or smoothness is desired. If the surface of a flat object is only covered, this coating may be afterwards peeled off; but if the object is surrounded with copper, as a vase or statue, the coat will be adherent.

Rubber Stamp Ink for Metal, etc.—Ordinary rubber stamp inks are not suitable for marking wood, tin, glass, or similar substance, as ordinary stamp ink is soluble in water, and therefore easily removable. Try the following. Dissolve by gentle heat 1 part of asphaltum, ground to fine powder, in 2 parts of turpentine, and with this incorporate thoroughly 1 part of lampblack ground in turpentine. If the ink is too thick, a little turpentine may be added.

Re-caning Chair Seats.—Below are instructions on re-caning chair seats. Before using, the cane lacing must be allowed to soak for twenty-four hours in a tub of clean water. In the meantime remove all the old caning from the chair, and bore out with a gimlet or brace bit any holes that are filled up with broken pegs. In the accompanying illustration each line represents a strand of cane, there being six strands in all. Taper a quantity of wood pegs to fit the holes; the use of these will be explained later. Begin by lacing two strands in each hole as A, pull the cane as tight as possible, and whilst still holding it knock one of the pegs in the hole; this will hold the cane tight until the next row has been laced. The second lacing B is in the opposite direction to A, the separate strands being interlaced alternately with those first put in; these are also two strands to one hole. The third lacing C is a single cane running diagonally across the seat, and interlaced alternately over and under the double strands. The fourth lacing D is also a single cane running in an opposite direction to C, and is also placed diagonally to the first cane. The method of



Re-caning Chair Seats.

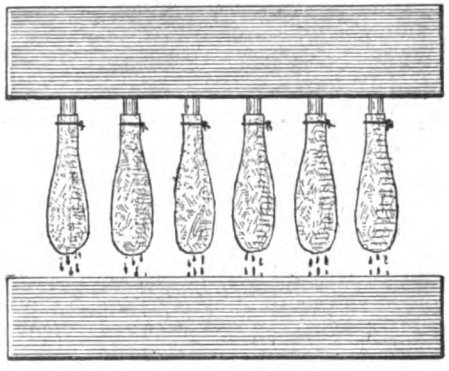
interlacing first adopted must be followed throughout, or a broken pattern will result. After the caning is done, the holes are hidden by a border cane E, which is laced down by putting a piece of narrow stuff through the hole from underneath, passing it over the border cane, and back through the hole again. All knotting or jointing of cane must be done underneath, and if near a hole knock in a wood peg to secure the cane. A stout steel skewer will be found very handy for reaming out holes and opening canes in lacing.

Remedying Shrunk Skirtings.—When the skirting boards have shrunk in drying and have left a space between themselves and the wall, the most satisfactory plan will be to remove them. Plaster the wall behind with a quick-setting plaster (such as 3 parts of lime to 1 part of Portland cement and 1 part of sharp, clean sand), then refix the skirting. It would be possible to "tuck in" plaster-of-Paris with a spatula or small trowel, but the result would not be so satisfactory, and there would be greater risk of damaging the paper.

Re-polishing Table Tops.—In French polishing old table tops first wash them with soda-water (a cupful of common washing soda dissolved in 1 gal. of warm water) to remove grease, etc.; if necessary, use also powdered pumice or Bath brick. Then overhaul them for bruises and repairs, and where required remove the old polish with a cabinetmaker's steel scraper; if not too bad, remove the upper surface of the polish by sprinkling with spirit and well rubbing with No. 1 glasspaper. Then wipe over with raw linseed oil to assist the new polish in taking more kindly to the old; use a grain filler where required, and body up all bare places. Taking three tables in hand, body up well all over and, on those from which the old polish has been removed, apply a thin even coat of spirit varnish; also varnish all moulded edges. Set these tables aside and treat three more in a similar manner; then follow on with three more. Now return to the three tables first taken in hand, body them up well, and, as the grain gets well filled up, add a little glaze to the rubber to bring the shine up quickly, and instead of using a rubber made of wadding, spirit off with a swab of clean rag made fairly damp, but not wet, with spirit. If the tables have been worked up on the American system of oil varnish it will be difficult to remove the old varnish with a scraper or spirit; in that case, pumice powder or oil must be employed, instead of using spirit with the glasspaper.

Gold-filled and Rolled-gold Jewellery.—"Gold-filled," "rolled-gold," and "gold-cased" jewellery mean the same thing. The material is supposed to consist of a plate of gold brazed to a plate of brass and the resulting double-plate rolled out thin. Jewellery or watch cases made of this material consist of brass with a very thin surface of hard gold. Obviously it can be of any quality and thickness, from 18-carat rolled-gold watch-cases guaranteed to stand acid outside and to wear twenty years, to jewellery in which the 9-carat gold covering is as thin as electro-gilding. Also, much cheap electro-gilt jewellery is fraudulently described as "gold-filled," etc. The test is to file a deep nick in such articles and apply strong nitric acid to the exposed section. The brass portion will turn green, while the gold skin will remain unaffected and its thickness be at once shown.

Filter for Syrups.—The syrup filter shown by the accompanying sketch consists of a shallow tank, in the



Syrup Filter.

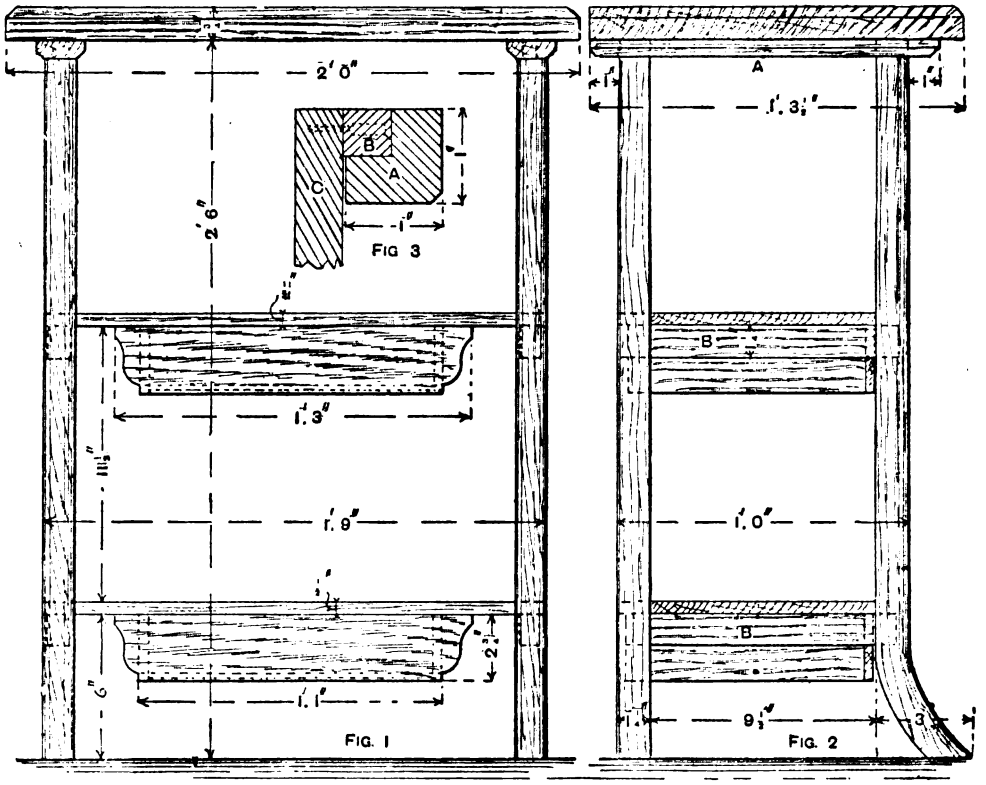
bottom of which are six or more holes fitted with nozzles, to which are tied long flannel bags. The syrup is poured into the tank and fills all the bags, through which it filters very rapidly. The tank may be made of wood, but should be lined with lead, or, if the syrup is acid, with tin. A filter press is the best thing to use. To decolorise syrup a charcoal filter is required.

Machine for Grinding Small Castings.—For trimming up either brass or iron castings, a small machine is much better and also quicker than using a file. A suitable grinding apparatus might be made as follows. Procure two small iron brackets, about 6 in. high, and of a shape and strength that an 8-in. emery wheel and a small turned pulley about 3 in. in diameter might be fixed on a spindle running in two small brass bearings. Next obtain a treadle sewing-machine stand, and in place of the small driving wheel fix a heavier wheel having a turned groove to carry the band. Fix the bracket, spindle, and emery-wheel over the flywheel so that the band on the flywheel will run true with the small turned pulley. Should the driving-wheel not be heavy enough, weight it by bolting to one edge of it a bar of iron or lead. Such a machine will answer well for light castings, such as gasfitting castings, etc.

Lithographers' Transfer Ink.—The following are recipes for lithographers' transfer ink. (1) White soap 10 parts, white wax 10 parts, mutton suet 3 parts, shellac 5 parts, mastic 5 parts, and lampblack 3 to 3½ parts. (2) Mastic in tears 8 parts, shellac 12 parts, Venice turps 1 part, wax 16 parts, tallow 6 parts, tallow soap 6 parts, and lampblack 4 parts. Melt the mastic, shellac, and turps together, then add the suet or tallow and wax; when these are melted, add the soap (cut into thin shavings), slowly mix, then add the lampblack and stir thoroughly. Pour the mass into moulds or on to an iron plate to cool.

Bleaching Hair.—To bleach black or brown hair to a pure white, first thoroughly wash it in a hot soap bath, and then place in a solution of hydrogen peroxide to which a little ammonia has been added; after several hours steeping the hair should be removed and allowed to dry in the open air. This process should be repeated several times, and finally the hair may be run through a dilute bath of aniline blue to correct the yellowish tint.

Small Fancy Table.—The small table shown in Figs. 1 and 2 is intended to stand in front of a window for plants, etc., to rest on. The top is of ¾-in. wood, and the edges can be moulded or bevelled as shown. The legs are of wood, 1¼ in. square, the front ones bending forward at the bottom with the front side rounded, so that in cross section they are like a D. The legs are tenoned at the end to fit mortises in A (Figs. 2 and 3), which is 2 in. wide and 1 in. thick, and bevelled at the edges. The ledges B are 1¼ in. by 1 in. The shelves are of ¼-in. or ⅜-in. stuff



Small Fancy Table.

screwed to B, their edges being bevelled or moulded. Two small drawers are fitted under the shelves. The dotted lines in Figs. 1 and 2 show where the sides of the drawers come, and the projecting pieces hide the bearers shown in section in Fig. 3, where C is the side of the drawer. A piece of wood ¼ in. square is screwed flush with the top edge of the side. The bearer A is screwed under the shelf. A small brass handle should be screwed to the front of each drawer.

Electrotypes of Medals, Coins, etc.—For taking an electrotype copy of a medal or coin, a battery and a bath are necessary. A Daniell battery is mostly used for small jobs. To make this, get a copper pot and place inside it a porous pot, which can be obtained of any electrical dealer. Fill the space between the pots with water, and add sulphate of copper till no more will dissolve and a few pieces are left undissolved. Put enough water in a jar to fill the porous pot, add as much common salt as will dissolve and a little over, and pour into the porous pot. A rod of zinc is placed inside the porous pot with the salt solution. A copper wire is led from the zinc to the article to be coppered, and another wire from the copper pot to a sheet of copper hung opposite to, but not touching, the mould to be coppered. All the parts where wires join zinc and copper, etc., must be brightened by scraping off the oxide, and tightly held together by twisting or by binding screws. The mould and copper plate are placed opposite to, but not touching, each other in a bath. This can consist of a glass jar containing distilled water or clean rainwater in which has been dissolved as much sulphate of copper as it will take. The water may be warmed to help dissolve the crystals. To each pint of the sulphate of copper solution add half a fluid ounce of sulphuric acid. A muslin bag containing sulphate of copper crystals should be hung on the side of the bath. The copper plate opposite the mould should be scraped bright at the commencement. Having taken a mould of the medal, carefully dust it with blacklead, and brush it till no more will stick to the surface. Cover the back and all other parts not to be coppered with melted wax. Make a hole or channel in the rim of the mould, and bind there the end of the wire from the zinc. Cover the wire and binding with wax, all except the end, which must be brightened and touching the blackleaded surface; then hang them in the bath for twenty-four hours. If the deposit is black or brownish it is being put on too quickly, in which case move the mould and the copper plate farther apart. When finished, anneal the electrotype by making it red hot (but not melting it) in a Bunsen flame.

Lubricating Piano Action.—Blacklead as sold in packets in powder form should be employed for lubricating the action of a piano. When used as a lubricant on sliding portions, as for a shifting hammer rail or a key frame, the lead should be mixed with tallow. On parts that are to be burnished, such as hoppers and regulating studs fixed at the extreme ends of the keys immediately under the action, the blacklead should be mixed with methylated spirit. Apply the mixture with a chip of wood to the parts to be burnished, then with a burnisher rub off and polish up bright. The burnisher closely resembles a razor strop; it is a flat piece of wood about 1 in. wide by 10 in. long, with a handle cut at one end, and is covered on both sides with chamois leather, one side of the leather being touched with blacklead.

American System of Polishing Furniture.—In the American method of quickly polishing furniture patent grain-fillers are largely used, and the surface is built up by repeated applications of varnish instead of applying lac solutions with a pad. The glarish look of the varnish is removed by rubbing down with pumice-stone powder. On high-class goods the brightness is then restored by friction; on cheap-grade goods a flowing coat of superior quality varnish is applied as a finish. The varnish employed is, as a rule, much thicker than spirit varnish as used in English cabinet shops, and is mostly of a soft variety, easily scratched and showing up white marks. To get a fair margin of profit, articles finished by the above method must be done in large quantities.

Box Wheelbarrow.—Figs. 1, 2, and 3 show a small box wheelbarrow for use in the garden, etc. The wood for the sides, ends, and bottom should be ⅞ in. to 1 in. thick, housed and nailed together as indicated. The legs and wheel should be cut from 1½-in. stuff, the legs being shaped as shown.

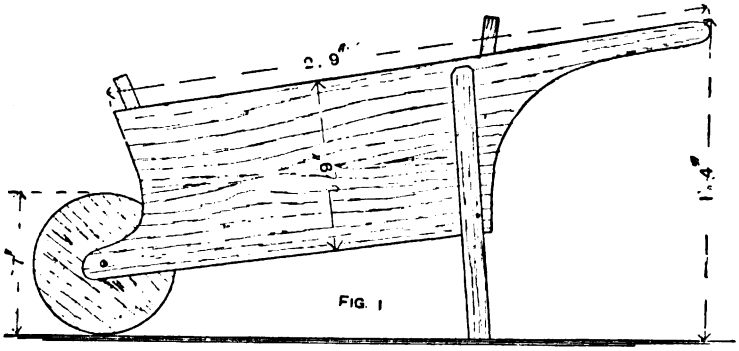


FIG. 1

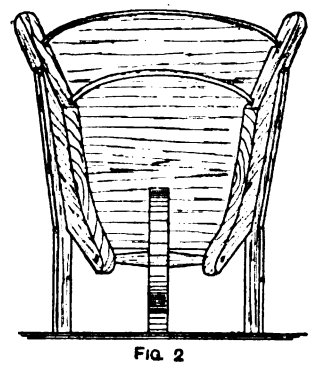


FIG. 2

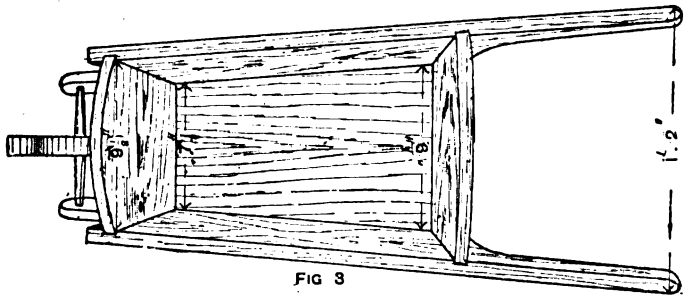


FIG 3

Box Wheelbarrow.

Painting Ralli Car.—A description is here given of the best way to paint a new ralli car, its body to be black and the wheels, shafts, etc., to be blue picked out red, the whole to be well got up. The body should have three priming coats of good tub-lead colour, a day intervening between successive coats; it should then stand for two days to harden, when it is ready for filling up with filling powder mixed with white lead, turpentine, gold size, and the dregs of varnish cans. The body, having had six coats of filling and been stained, is left to stand for a week. Level some lump pumice-stone by rubbing it on an old file or on a sandstone; then with an old sponge or canvas swab wet a portion of the filled-up surface and rub with the pumice-stone, using enough water to prevent the stone clogging. After being washed over, the staining coat will show how it is rubbed, and the whole of the body should be worked upon until all the staining spots disappear. The filling-up on all edges under the body should be cleaned off, and the body, after standing a day, should be lightly glasspapered, and a coat of light lead colour given to stop what suction there may be in the filling-up. When the colour is hard it is faced off very lightly to remove brush marks and nibs, after which the body should be carefully examined to see whether any small places require stopping up; if so, this should be done and faced off before the next coat of dark lead colour is applied. This, when dry, is very lightly glasspapered, and a coat of dead black is given. In the meantime the wheels, etc., should have been brought along in colour, having had two coats of light lead colour and one of dark lead colour, being cut down with glasspaper to get a surface between the coats. For the blue parts, use one coat of Prussian blue and two coats of ultramarine, the last coat of blue having a good proportion of varnish in it to produce a good surface for lining out. The body should have a coat of shiny black, which, when dry, should be sponged off hard. Then give the first coat of black japan, but before a second coat is put on the body must be flatted down. To do this, take some pumice powder and a pad of rag with water so as to make it work freely, and wash off frequently to ascertain whether a dull uniform surface is obtained. Be careful not to rub through at the edges or beads on the body, and wash off thoroughly. When the body is flatted all over, give a final wash off, using the water tool freely wherever required, so that not a particle of dust remains. After it has stood an hour or two for the moisture to evaporate, give it a full coat of japan, being careful to get no runs, and laying it off and then leaving it alone, as both japan and varnish are often spoilt by being worked about too much. Let the body stand for two days to harden, the wheels, etc., in the meantime being flatted, as the body was done, ready for lining out. For this, vermilion or carmine red is used, mixed in a small dipper with pale carriage varnish to a creamy thickness. The lines are then put on with camel-hair or sable pencils, called fine liners, and picking-out pencils. To use the colour, have a dipper of turpentine beside the colour and a palette close at hand, and dip the pencil in the turpentine, then in the colour, and on the palette, working it to load it properly. Hold the pencil between the thumb and the forefinger of the hand, using the second and third fingers as a gauge and guide for the lines. The work, after being washed off again, is ready for the first coat of varnish, and if the cart has been kept in a clean, dry loft, a dusting off will do after lining out. If there is much dust on the cart, it is best to wash it off. Undercoating carriage varnish or body varnish, as the case may be, should be used, and this should dry in about twelve hours; it should stand for a day or more if possible before being flatted for the finishing coat. Flat sufficient to remove small nibs or brush marks only, as the more this coat is flatted the less gloss will there be on the finishing coats, owing to the under coat absorbing the varnish. The last coats should be of best finishing varnish for both the carriage and body, and should dry in about two days in good weather, but should not be handled for at least a week, and should then stand another week before being used. To make a successful job of any good painting, it should be done in a light, well-ventilated shop kept at an even temperature and free from damp and draughts, as chills and sudden changes of temperature soon spoil varnish.

Copying Letters into a Letter-book.—There is but one method in common office use for taking a copy of a written letter in a letter-book. Briefly, it consists in bringing the surface of the written sheet into close contact with a moistened leaf of the letter-book. This contains generally either 500 or 1,000 leaves of thin, white, rather transparent paper; for copying type-written matter, the paper is thinner and still more transparent, being of the kind known as "Japanese." Usually a letter-book is half-bound in leather, the great pressure which it has to withstand, and the rotting effect of the water, rendering necessary an exceptionally strong binding. The leaves measure usually 8½ in. by 10½ in., and are numbered consecutively in the right-hand top corners on their front faces. Other requisites besides the copying-press are brush and water-well, sheets of blotting paper or special drying sheets, and oil sheets. A modification of the process of copying renders necessary cotton cloths, slightly larger than the letter-book page, and a tray to hold the cloths. The brush may be of camel-hair, and have a width of 3 in. or 4 in., or it may be of "patent felt," with a width of from 3 in. to 6 in. A felt brush is illustrated in front and side views by Figs. 1 and 2. In the section shown by Fig. 3, F indicates the folded felt, I a wedge-shaped piece of vulcanised, pliable

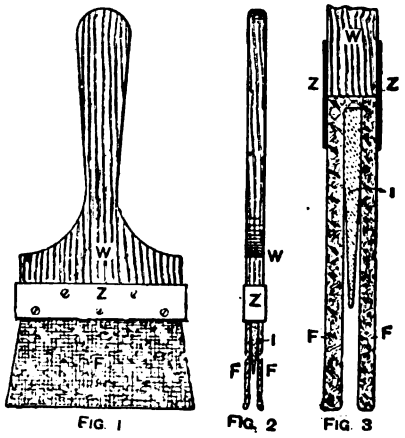


FIG. 1 FIG. 2 FIG. 3

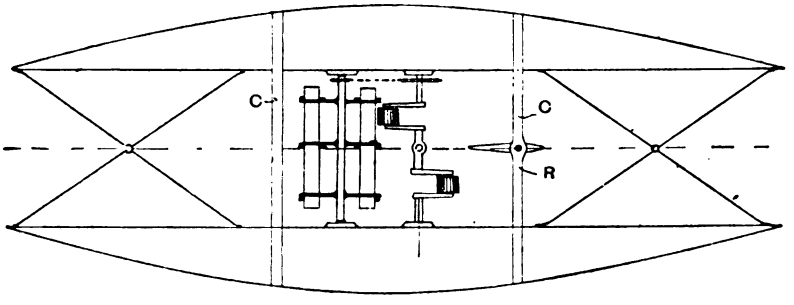
Felt Brush used in Letter Copying.

indiarubber, which prevents the felt collapsing, and Z a strip of zinc, which is folded round so that its ends overlap, and which is screwed to the felt and rubber and to the wooden handle W. The letters in Fig. 1 have similar meanings. This felt brush may be 8 in. long, 4 in. wide above the zinc strip, increasing to 4½ in. at the bottom edge of the felt, the wood being ¾ in. thick. Felt brushes hold more water than those of hair, and are practically everlasting. The water-well is often a reservoir of china or tinplate, with a cover in which is a slot, through which the brush can pass; but a well can be improvised from any vessel capable of holding water. The drying sheets are specially prepared, but thick, white, and highly porous blotting paper does equally well. It should be cut 1 in. longer and ¼ in. wider than the leaf of the letter-book. The oil sheets, also, are special preparations, and probably can be bought more cheaply than they can be home-made. To prepare them, thick hand-made paper is coloured yellow by immersion in a decoction of annatto or turmeric; when dry, the paper is soaked in a mixture of equal parts of castor oil and alcohol, and the sheets are then hung up separately to dry. The following is the method generally adopted in making copies of matter written with copying ink. Lift up the letter-book right-hand page on which the fac-simile is to be produced, and insert beneath it an oil sheet. Then, with the brush damped, evenly moisten the page, leaving dry the right-hand top corner, on which is printed the page number, and the extreme left edge of the page; if this edge is wetted, the strength of the binding will be affected in time. To remove surplus moisture, place a drying sheet or two over the wet page, an oil sheet on the top of this, close the book, and place it in the copying-press with the bound back of the book projecting from between the plates of the press. In all the press operations the back edge of the book must not be pressed, or it will be broken and the pages will become loose. On this preliminary pressing depends the success of the process; if the pressure is too great and too much moisture is removed, a faint and probably imperfect copy will result; whilst if insufficient moisture is removed, the reproduction, together with the original letter, will be blurred, and perhaps covered with small stars, the superfluous moisture causing the ink to run. Remove the book from the press, and, placing it on the table with its front cover downwards, open it at the oil sheet which was inserted first. As the book lies open, the oil sheet will be on the back of the left-hand page. Move it to the face of the right-hand page and place the letter, written side up, on the oil sheet, and bring over the damp page until it covers the letter. An experienced worker will here perceive whether the page is properly wet; the beginner will not be able to do this, and will attain success only through a few initial failures. Remove the drying sheets which now lie on the left-hand side, cover the damp page with the second oil sheet, close the book, and place it in the press. Generally, the whole of the pressure it is possible for the worker to exert will not be too much in this part of the process; a few seconds' pressure is all that is necessary. Remove the book from the press and open it at the second oil sheet. Then by lifting up one corner of the page it can be seen whether or not the copy is good. If too faint, a few seconds more in the press may improve it. Perhaps, whilst the page is being slowly lifted from the letter, an area of a square inch or so will be found to be faint and imperfect owing to uneven wetting or to the use of blotting-paper on just one portion of the letter whilst it was being written. In such a case, allow the page to fall into its correct position over the letter, and, with a rather damp cloth pad, press on the faint part; this often suffices. When inserting the letter beneath the damp page in the letter-book, often the page is found to be either too wet or too dry; in the former case an unused drying sheet may be placed over the wet page which covers the written letter, and the book is placed in the press as usual; in the latter case, a wet drying sheet from the previous operation may be used in the same way, care being taken to cover it with an oil sheet before pressing. The oil sheet prevents the moisture passing to the other pages, for if the page above the letter is not covered with the oil sheet or something similar, the writing will be copied upon two pages, the ink passing rapidly through the moistened tissue paper. It is possible to copy twelve or more two-page letters at one time. The points to be remembered in copying many letters at once are: (1) thoroughly and evenly to wet the pages (they are kept together until ready for the letters to be inserted) and (2) to maintain the proper order of oil sheet, letter, and damp page, that is, supposing that the first oil sheet is placed on the right-hand page, and that the working is backwards; thus the first oil sheet might be laid on p. 60 of the letter-book, the letter inserted and covered by p. 59, another oil sheet, another letter, and then p. 58, and so on. For copying typewritten letters the method above described may be employed; but the general opinion is that better results are obtained by applying the water with wet rags rather than with a brush. The procedure is as follows. Beneath the letter-book page place an oil sheet, and on this the type-written letter to be copied; cover it with the dry page. The rags are cotton cloths slightly larger than the letter-book page, and may be conveniently kept in a sheet-metal tray or other vessel capable of holding water. A rag is made thoroughly wet, the superfluous moisture is wrung out, and the rag is smoothed and placed on the letter-book page above the letter. Cover the rag with an oil sheet and press the book as usual. Many of the instructions given above for written matter apply in this case also. For matter executed by a typewriter having a new ribbon or a freshly inked pad, the rags are not so wet as when the typewriting is faint. After letters have been withdrawn from a letter-book, keep the oil sheets between the leaves until these are quite dry, or the copies will be duplicated on the adjoining pages. A copy found to be too faint when the book is removed from the press may be very considerably darkened by being exposed for a few seconds, while still damp, to the fumes of common ammonia. The ammonia is best kept in a wide-mouthed jar or bottle, which should, of course, be securely corked except when in use. In the case of separate flimsy sheets, they may be drawn across the mouth of the vessel containing the ammonia; but as it would be awkward to hold a book in an inverted position, it might answer to keep a very weak solution of the ammonia and brush it over the faint copy. This, however, is only a suggestion, which cannot be answered for from practical experience; but the use of the ammonia fumes can be recommended strongly.

Iridescent Colour on Copper.—To give what is called an iridescent colour to a copper plate, this must be ground and buffed, then hammered over on a bright anvil with a small round-nose hammer, making the indentations close together, but not so as to overlap each other. To retain the colour, lacquer over when hot with colourless lacquer or zapon.

Composition Firelighters. — There is no cheap method of making firelighters out of sawdust and shavings. The cost of binding and the extra labour and plant involved in the manufacture of composition firelighters of any kind make them nearly as expensive (in some cases more expensive) to produce as properly made wooden ones. They are, besides, less clean to handle and to stock. One of the best composition firelighters is made by saturating the sawdust and *chopped* shavings with only sufficient resin to make the various particles stick together. The material is then placed on a long narrow belt of tough paper. The edges of the paper are rolled up about the sides of the material, and gummed together at the top, just as in cigarette making. When the resin has set hard, and the roll has become stiff and strong, short sections are sawn off at the ends—like cutting pieces off the end of a pole. Both sides of the discs are then sealed, to prevent any part of the interior from falling out, by being floated over a shallow tray of resin. Tar is sometimes added to the resin or used in place of it, and the saturated composition pressed into brick form while hot. Chopped straw and moss are also used in conjunction with sawdust. The soaking mixture may be varied indefinitely. Wood creosote oil may or may not be added to the resin, and petroleum fat may form 20 per cent. of the liquid employed. This class of fuel is covered by numerous patents.

Bicycle Boat.—The accompanying illustration shows a plan to scale of a bicycle boat 16 ft. long by 6 ft. over all, having twin hulls each 1 ft. 4½ in. broad by 1 ft. 3 in. deep, leaving a central space 3 ft. broad. The boats are

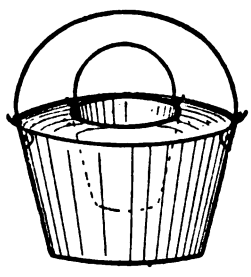


Bicycle Boat.

fixed together with two heavy cross-beams C, and have ½-in. galvanised-iron stay rods at each end to prevent any fore-and-aft movement. Power is transmitted by means of a paddle wheel 2 ft. 6 in. long, and 1 ft. 6 in. in diameter, having eight blades each 5 in. broad. This wheel is geared to the driving axle with the usual chain and sprocket wheels, the speed ratio being 70. The throw of the crank should be about 7½ in. The centre of the paddle shaft is 10 in. above the bottom line of the hulls. A boat of this catamaran type has the requisite stability to enable the rider's saddle to be placed at any convenient height without endangering his safety. The rudder R is placed where shown, just far enough forward to ensure a comfortable reach to the handle-bars; the distances and heights of saddle, etc., should be the same as that of an ordinary bicycle frame.

Polishing Pitchpine Coffins.—In polishing pitchpine coffins success depends as much on the method of working and mode of application as on the materials used. For convenience of handling it is advisable to nail on the top of the work-bench two strips of wood about 2 ft. 6 in. long by 3 in. by 1 in., as used by coffin makers when cleaning off. These overhang the front about 1 ft., and are at a distance apart just sufficient to fit inside the coffin to prevent it slipping about. First wipe the body part over with raw linseed oil, and, if possible, the top, which is wiped over next, should rest across two ledges on another bench. Grain fillers are not used on pitchpine, and the treatment partakes much of the method of French polishing in conjunction with spirit varnish. Just how much of the materials used should be put on, and when to leave off, are knacks that must be acquired. The body part being oiled in, fairly saturate an old polish rubber with polish, and with a light swinging motion apply it to one side and the head end. Do not use a rag covering to the polish pad, but work out fairly dry, covering every part alike. When two or three applications have been thus laid, fill all nail holes with putty slightly coloured with yellow ochre and wipe off clean with a piece of rag. Then apply a coat of spirit varnish, reverse or turn over, and treat the other side and foot end in the same way. Whilst the body part dries, treat the top similarly. Should undue roughness assert itself, smooth it down with worn glasspaper, always working in the order first started upon. Make the polish rubber fairly wet with polish and put on a rag covering; work it all over the side and head in a straight direction at first, then circular, finishing straight. Use a few spots of oil and thin out the polish in the pad if it has any tendency to stick or drag. The object of this rubber is to make level the coat of varnish already laid; this being done, apply another coat. Next turn over and similarly treat the other side and foot, and then the lid. In the majority of cases the coffins should now look well if the varnish has been evenly laid on. Another coat would produce a decided improvement, or if a superior finish is desired the varnish surface may be levelled down and its brightness restored or greatly enhanced by the application of glaze put on by a rubber kept specially for the purpose. However, it will generally suffice to add a few drops of glaze to the polish rubber already in use. Spiriting out is rarely resorted to, a bright level finish being all that is desired. The varnish and glaze should be carefully strained, the varnish being applied by a camel-hair brush. The time for the work on a full-size coffin is two hours to two and a half hours.

Copper Glue-pot.—The copper glue-pot represented by the sketch can be made of No. 22 B.W.G. sheet copper. The pattern of the outer pot, or water container, is that of a truncated cone, and the method of setting out is described in Series I., p. 37. Working

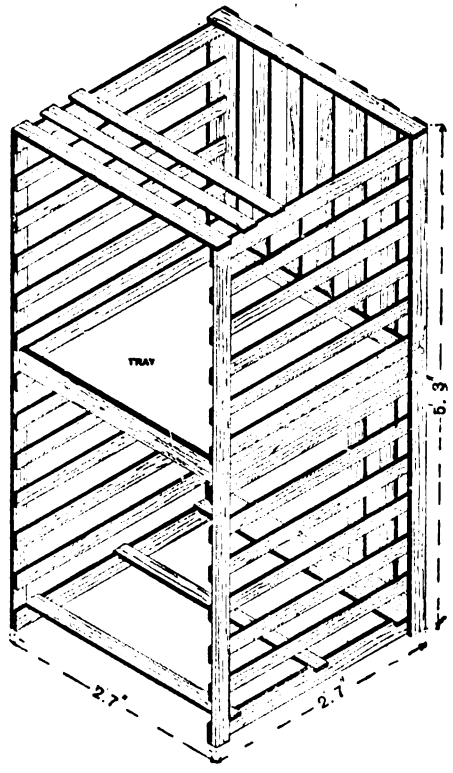


Copper Glue-pot.

edges for seams must be allowed. The pattern should be well rolled, and small edges along the radial edges may then be set off opposite each other for grooving. Bend the pattern to shape, groove the seam, and set off, at right angles to the body, the edges represented at the top and bottom of the pattern. The top is a hollowed ring of copper, which should be cut so large that, after hollowing and edging, it can be fitted to the top of the body. The centre, which should be equal in diameter to that of the top of the glue-pot proper, should be cut out after the top has been hollowed. A wired bead equal in diameter to that of the centre hole is attached by beating it over on the inside of the top, after which the top is paned on to the body and beaten up. The bottom is a disc of copper, which is edged to fit the body. But before this is fixed, rivet to the body two ears to which the handle is attached as shown. The top is strongly soldered round from the inside and the rivet heads are soldered over also. The bottom can now be paned on and beaten up and strongly soldered from the inside. A suitable handle is a piece of ¼-in. round iron bent to shape and hooked through the ears. The pattern of the inner pot can be set out by adopting the principle used in setting out the outer pot. A wiring edge should be allowed on the top of this pattern; also allow edges for the grooved seam and the bottom. The inside surface will be much improved by tinning, after which the piece is rolled, edged, wired, bent to shape, and grooved. The edge for the bottom is then set off, the bottom is cut out, tinned, edged, paned on, and beaten up. The bottom should be strongly soldered round from the inside. A pair of suitable ears are riveted opposite to each other at the top of the inside, and are rendered sound by soldering. A piece of No. 8 B.W.G. wire, bent to shape and fixed, serves as a handle.

Colouring Prints. — In colouring prints made on ordinary paper, mix a little ox gall with the paints, or lightly rub the print with ordinary white chalk. The chalk need not be rubbed on so hard as to damage the print, and any white marks may be easily dusted off.

Crate for carrying Flower Trays.—Below is an isometric sketch of a light, strong, and easily constructed crate for carrying trays in which cut flowers may be conveyed. One of the trays is shown in position. It will accommodate twelve trays 3 in. deep by 2 ft. 6 in. square, and is composed of 2-in. by ¼-in. battens, fastened together with wire nails, and spaced 3 in. apart. This dimension could be altered to suit any depth of tray; 3 in., however, is a convenient depth, and the width of the battens (2 in.) allows sufficient clearance for flowers standing above the tops of the trays. One tray is shown in the illustration, but the door and a portion of the top and back battens have been omitted for clearness. The door would be constructed similarly to the back, the battens being nailed to two cross ledges, and hung with a pair of 2½-in. butts and fastened with a hasp and padlock. To construct the crate, cut the various pieces to the required

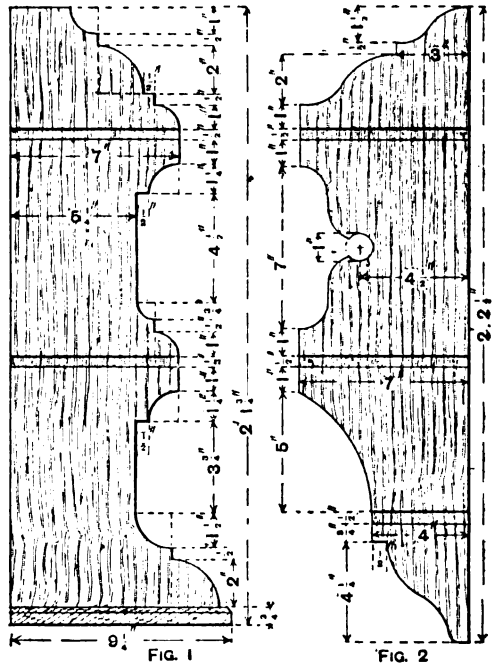


Crate for carrying Flower Trays.

lengths, then lay two of the four uprights on a flat surface, and nail on the bottom and top battens flush with the ends. Square this frame; this can be done with a carpenter's square, or by trying a rod diagonally across the opposite corners, marking the length in one direction and making the other equal with it, racking the frame until the lengths are the same. Obtain a piece of wood ½ in. wider than the trays are deep outside, and interpose it between the edge of the bottom batten and the next one, and nail the latter on. Repeat the process till all the battens are nailed on. The other side is served in the same way. Then notch out the bottom battens on each side to receive the cross-bearers as shown; note that the back piece should finish flush outside. The top battens are simply nailed across, and may overhang so as to be flush with the corner-pieces. The back opening should now be squared and the battens nailed on in transverse direction to the sides. If the crate has to travel by rail, or is likely to be roughly used, it would be advisable to nail braces on the two sides in contrary diagonal directions. To prevent the flowers being stolen, fine mesh wire netting should be fastened with wire staples round the top and sides, and to preserve them against dust or cold winds, stout brown calico might be tacked on. The trays are usually rebated together at the corners and nailed, and a cover-board fitted in on strips flush with the top, this board being pierced with holes to hold tin tubes or in some cases glass bottles. As a further security, the top and sides might be filled in with ¼-in. match-lining, but this would considerably increase the weight. The batten stuff can be obtained cut to size at any retail timber dealer's, and would not need planing.

White Paint for Steel.—A good white paint for steel girders under cover would be equal parts of zinc white and white lead. Bleached linseed oil (raw) and benzoline in equal parts should be used for the first and second coats, and the third and last coat should be thinned with French oil varnish and one-eighth turpentine. Red lead should not be used as a base for a white finish.

Designs for Bookshelves.—Fig. 1 is a design for the end of a bookshelf to stand on, say, a table. One to stand on the floor might be made from the same design enlarged and with short feet added. The wood for the



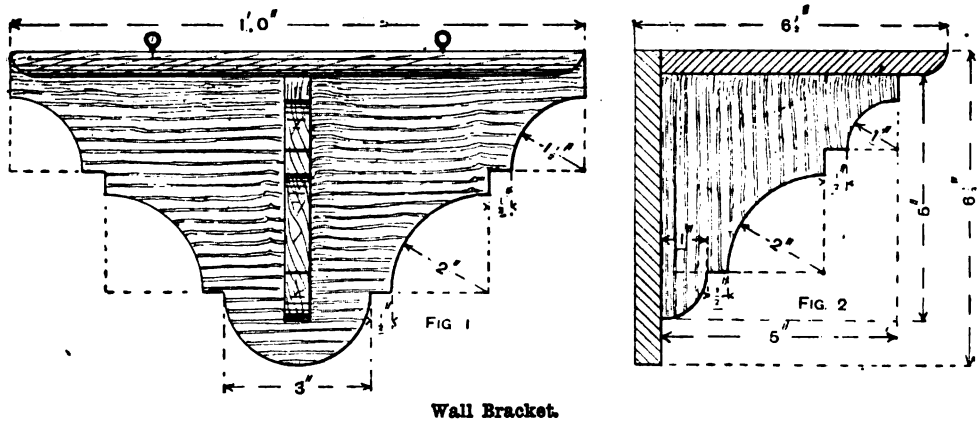
Designs for Bookshelves.

ends should be ¾ in. thick, and the base may project ½ in. beyond the sides at each end. Fig. 2 shows the side of a hanging bookshelf, most of its curves being drawn freehand. In both cases the housing for shelves is ¼ in. deep. They should be 18 in. or 20 in. long and ½ in. thick, and the sides should be housed into the base.

Ventilating Schoolroom.—There are but two ways of ventilating a room in a satisfactory manner, one way being by a chimney which works actively as an air extractor, free of cost; the other way is by an air propeller which costs something for motive power and attention. For one or two rooms a chimney, if there is one available anywhere near the rooms, is amply sufficient. If the chimney is in a room adjacent to the classroom, a square hole can be cut in the wall at the back of the chimney and an adjustable ventilating grating fitted into the hole. If the chimney is not so conveniently situated, then a tin or zinc air-tight tube can be taken from the classroom to the chimney. The inlet opening for fresh air, which should be as remote as possible from the outlet into the chimney for foul air, can be made at any point in the room wall. If an air propeller is used, a suitable position must be chosen for it, and then the position of the outlet has to be carefully considered. It is not a good plan to attempt to propel air into a room which has no outlets for the existing vitiated air, neither should this vitiated air be forced to travel into and through other rooms before it can escape out of doors.

Bending Glass.—In the works, large pieces of glass are bent to shape on iron moulds; the mould need not be solid. For a curve, the mould may be made of ¼-in. wrought iron which has previously been bent to the required shape. The mould, with the sheet of glass on it, is placed on the floor of a furnace similar to an annealing kiln. As the heat rises the glass gradually softens and assumes the same curve as the iron mould; it should then be removed to the annealing oven. If many pieces of the same shape are required, the mould should be left in the furnace, and sheets, taken one by one from the annealing oven, should be placed upon the mould and quickly removed to the annealing oven when they have assumed the necessary curve. The temperature of the kiln need not be very high, as the glass will easily bend at a low red heat provided the mould and the glass are both at the same temperature; at a higher temperature the glass would commence to flow and could not be moulded properly. Small articles made from thin glass have a curved form when blown; any particular curve is obtained by blowing the articles in a mould or by opening them out with an iron rod. The mould for bending the glass could be cut in stone if desired, but any other material would be too rough. (See also Series I., p. 207.)

Wall Bracket.—The wall bracket illustrated by Figs. 1 and 2 may be made of ¼-in. wood. Fig. 1 is a front view, and Fig. 2 shows the shape of the support, the shelf and back being in section. If the back is sawn with a fret-saw from a piece of wood 18 in. long and 7½ in. wide, there will be enough wood left on which to repeat the back part (Fig. 1), and so get the back of another bracket. Similarly, by sawing the support from a piece 5 in. by 6 in., another support (Fig. 2) can be obtained.



Wall Bracket.

Asphalt Roof for Conservatory.—The flat roof of a conservatory may be constructed of flooring-boards, concrete, and asphalt, so as to form a balcony. The flooring-boards may be covered with a layer of concrete 1½ in. thick, composed of 1 part of Portland cement, 2 parts of sand, and 4 parts of gravel or chippings of ¼-in. gauge. On this concrete put a layer of natural bitumen or asphalt, ½ in. thick, laid with a fall to carry off rainwater. The so-called asphalt made with a mixture of pitch and tar is not reliable in a position exposed to the sun. In course of time the flooring-boards, for want of ventilation, will rot. In order to prevent this, a better job would be made by nailing bearers on the upper side of the floorboards, and on these bearers placing concrete flags 2 in. thick and, say, 2 ft. wide. The joints between the flags should be pointed with neat Portland cement, and the natural asphalt laid as described above.

Finishing Wood Carvings.—In French polishing two carved panels, if they are of mahogany or walnut the colour may be enriched by brushing over with "red oil," which consists of 2 oz. of alkanet steeped in ½ pt. of raw linseed oil. The panels should then be allowed to stand for at least twelve hours. Grain fillers are not used, but roughness may be removed and the pores partly sealed up by well rubbing the surface with a wad of fine soft shavings, pressing firmly till a slight lustre appears. The same appliances and materials are required as for flat surface work, but, owing to the irregular surface, the wads must be kept very soft. When the surface has been brushed quite clean, apply polish wherever it may be possible, then rub in a little thin varnish, using a camel-hair brush; stab it well in the inner or undercut portions and allow this to get thoroughly hard, afterwards rubbing down with very fine glasspaper all parts that can be reached. Apply another coat of varnish, which will flow better if it has been slightly warmed; when this is quite dry, work over all prominent parts with a small rubber having a rag covering, using the polish rather thin—say about half polish and half spirit. Rub till the whole of the surface becomes bright, and use less polish as the brightness increases till a surface is gained similar to that obtained by spiriting off. Many people prefer to see carved work with a dull or semi-bright finish such as may be obtained by wax polishing or by dulling the shellac and varnish surface by well brushing it, when dry, with a stiff brush and fine-grade pumice powder or flour emery. Wax finish has the advantage that it enables the panels to be freshened up in a few minutes, and, in fact, better results are gained by thus treating the panels at frequent intervals than by long-continued rubbing at first. The wax finish can be made by dissolving good quality beeswax in turpentine till of the consistency of soft soap, while alkanet root steeped in the turps will enrich the colour of the paste and panels. The dilute wax may be applied with a flannel or a brush, and it should be well worked in, all surplus being removed and a lustre brought up by means of a stiff bristle brush such as a shoe brush. Instead of turpentine wax some prefer benzine wax, claiming that it does not clog the delicate or fine lines so much. To prepare it, put into a glass-stoppered or tightly corked bottle small pieces of bleached or white wax, cover it with benzine, and set it aside till it is dissolved and a paste is formed. This should only be used in daylight or with extreme care if by gas or artificial light, as the benzine is highly inflammable; it is used in a similar manner to turpentine wax. Should the panels be of soft white woods and require staining in order to match the surroundings, it is a wise plan first to close the pores partly by well rubbing the surface with fine shavings as previously advised. Water stains may be used, and may be improved by the addition of a small quantity of liquid glue or glue size; the addition prevents the subsequent applications of polish, varnish, or wax sinking in so deeply. In the case of stained work a rather quick method of finish is to body in with polish; then apply a coat of varnish, and when this is dry, bring up the lustre by means of a wax finish.

Acoustic Wires for Churches.—Acoustic wires are generally of steel, and ordinary piano wire of from No. 17 to No. 22 S.W.G. will be suitable. Hooks are fixed at one end of the wires; at the other end are tension screws, so that the wires may be tightened. In a church eight (or ten) wires should be fixed, six (or seven) parallel to each other, and two (or three) across the six (or seven) also parallel to each other; in height they should be from 8 ft. to 15 ft. above the floor level. Experiment will determine whether the wires should be tightened to the same pitch or not. First, tighten them to the pitch used by the minister when intoning the service; if this is found unsuccessful, tune them approximately to the different pitches used during the service both when reading, intoning, and preaching. The level of the wires may also have to be determined by experiment, and it may even be necessary to fix a sounding board over the pulpit.

Preserving Star-fish and Shell-fish.—The simplest method of preserving star-fish is to place them in a glass jar containing a suitable fluid, such as a saturated solution of table salt. Place as much salt in boiling water as will be dissolved, and allow to settle; pour off the brine, using filtering paper. Do not pass the thread which is attached to the object through the cork, as the brine will creep up the thread and deposit the salt on the cork. The thread should project from the side of the cork at a point below the neck of the jar. If the specimen is wanted dry, slit the rays of the star-fish along the under side from the centre to the points, and remove all the flesh. Then anoint the inside of the skin with arsenical soap, fill the cavity with tow or cotton-wool, and sew the cut edges together. To preserve crabs, do not boil them unless the change of colour is of no moment. When dead, they must be carefully cut at the joints, and all the flesh must be removed. The joints of the legs will not need cutting, as the matter in them, if exposed to the air, will quickly dry; the claws should be quite emptied. The body of the crab should be opened, and the liver or cream removed. The thorax, where the legs are articulated, will be rather difficult. When all the parts are clean they must be set in their proper positions by means of glue or cement.

Shop-floor Electric Alarm.—The device here described is intended to give notice, in the back premises of a shop or other place of business, of the entrance of any person. A hole, about 24 in. to 27 in. square, must first be cut in the floor, just within the entrance. Then a trap-door A (Fig. 1) must be fitted to work quite easily within the space without fear of becoming fixed, and should be hinged on the side nearest the street. The trap should

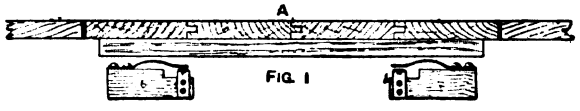


FIG. 1

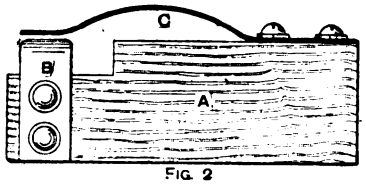
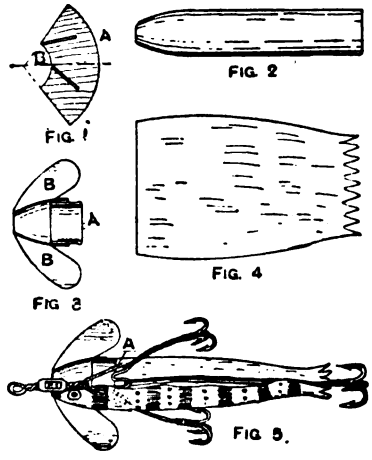


FIG. 2

Shop-floor Electric Alarm.

rest on the floor joists, additional supports being fixed if the trap does not agree with the distance between the joists. Two spring contacts will be required, one for each of the front corners of the trap. The contacts are shown separate in Fig. 2. To make them, plane up square two pieces A of teak or other hard wood, each 5 in. by 1½ in. by ¾ in. Cut a check 1½ in. by ¾ in. in one end of each, and then apply two coats of spirit varnish. Now make four springs of stiff, springy brass ¼ in. thick and ¾ in. wide, two B of them 1½ in. long, and two C 4½ in. long. The longer springs may be made of pieces of broken band saw, or other steel, but in that case a piece of brass or copper should be soldered at each point of contact with the other spring, as the softer metal is more readily kept clean by the abrasion. Fix the springs as shown with ¾-in. brass round-headed screws and washers so that, when the upper one is pressed down, it makes good rubbing contact with the lower spring, which, to ensure this, should be slightly curved. This rubbing action always keeps the contact surfaces clean, and, as the movement of the upper spring is about ⅛ in. to ¼ in. only, it will not take a permanent set if made of good material. The contacts are next firmly screwed to the floor joists, so that when the trap is pressed down the springs make good contact. They should be fixed some little distance from the edge, out of the way of any water or dirt that might find its way down. If, when the contacts are fixed in position, the trap stands a little above the floor level, it can be tapered down towards the edges with a plane, and should the weight of the trap alone make contact, the upper springs must be bent up until clear of the lower. In making connections the two upper springs are joined by a short wire, and also the two lower; the main wires to the bell and battery are then connected one to the upper and one to the lower spring. All the wires should be tightly screwed down under the brass washers. The line wires can be carried under the floor or otherwise to the bell in the back part of the premises, and a small switch should be connected in circuit, in order to cut out the bell when it is not required.

Artificial Minnows.—Here are a few hints on making artificial phantom minnows. To make the castings for the heads, cut a piece of thin sheet copper to the shape of Fig. 1, making the outer line A as long as the circumference of the body, and the inner line B equal to the circumference of the mouth. Polish the metal on both sides, brush over with "killed" spirit of salts, and with a soldering iron give a thin coating of solder on both sides. Now take a fine hack-saw and make two kerfs for the fins as shown in Fig. 1, the inclination of the top one with the outside line being the same as that of the lower kerf with the centre line. Bend the copper round an iron rod pointed as at Fig. 2, to form the head (Fig. 3), then make a ring A (Fig. 3) of the same material, and solder it into the hollow of the head. Cut out the fins B (Fig. 3), tin them all over with the soldering iron, and solder them into the two saw kerfs. Now cut a piece of Japanese silk or a piece of sole skin to the shape of Fig. 4. The silk may be red, white, or yellow, according to the ground colour of the minnow. Paint the material, then sew it up very neatly inside out, turn it, bend it back about ¼ in. at the top end and slip it over the ring A (Fig. 3), securing it in position with a little liquid glue or waterproof cement, and with the point of a knife forcing it well between the head and the ring. A turn or two of well-waxed silk



Artificial Minnows.

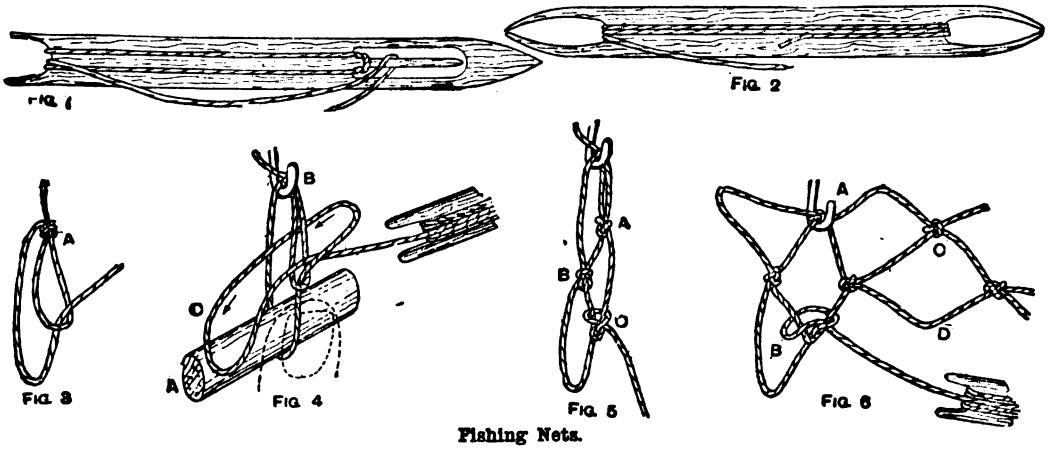
just below the head will make the body more secure. A good method of securing the flight of hooks is shown by Fig. 5. A triangular ring is formed with a piece of brass wire with three loops A, and the swivel is threaded on at the head and the ring brazed up at the side, the hook gut being attached to the three loops at the bottom of the ring. A small steel split ring is sometimes used, and, if necessary, the bait must be weighted with lead sinkers. To finish the minnow, give the fins a twist with a pair of pliers, and paint the head to the desired colour and markings.

Pointing for White Glazed Bricks.—A suitable damp-proof pointing for the joints of white glazed bricks is Keene's cement put in flush. Another method is to lay the bricks in bricklayer's putty instead of Portland cement, but this is not to be recommended in a damp situation, as the putty does not set readily. The putty referred to is a mixture of fine white sand, or marble dust, and pure lime that has been slaked in a large quantity of water, strained, and allowed to stand until it has become of the consistency of thick cream.

Split Nuts for Lathes.—In making a pair of split nuts, an ordinary nut with a good thread is cut in two depthwise across the diameter, a hack saw being used for the purpose. Then the sharp edges are filed off the thread, and the halves can be used for gripping studs, set-screws, bolts, etc., in the vice without damaging the thread providing it is the same in pitch as the thread in the nut. The split nut can also be used in the lathe to drive studs, etc., and in fact any other work having a suitable thread, a turner's carrier over it nipping it tight on the work to be driven.

Lead Tank for Oxalic Acid.—All acids, according to their strength, have a more or less destructive action upon lead. Oxalic acid forms with lead an insoluble oxalate of lead, hence a solution of oxalic acid has but little action upon lead, and it therefore can be kept in a lead-lined cistern. The seams of the lead should be burned together; solder must not be used because it contains lead and tin, which would, in contact with an acid liquid, form a galvanic couple, and the lead would be attacked, with consequent destruction of the joints. The joints should be as few as possible.

Fishing Nets.—The tools required in making fishing nets consist of a netting needle (Figs. 1 and 2) and a mesh-stick A (Fig. 4). Some prefer the needle shown by Fig. 1, others use the one shown at Fig. 2. Either pattern may be made from beech, pear, boxwood, or other close-grained, tough wood, about 6 in. long by ½ in. wide by full ½ in. thick; or a narrower one may be used for a smaller mesh. The mesh-stick A (Fig. 4) is a piece of oval hard wood or bone, about 5 in. long; the size will vary according to the size of the mesh. The method of winding the cord on the needles is shown at Figs. 1 and 2. To make a net, first tie a loop in the cord as at A (Fig. 3) and pass the point of the needle through the loop; then select a convenient nail or hook B (Fig. 4), and over it hang the knot of the loop. Now put the mesh-stick in as shown by A (Fig. 4), and place the first finger of the left hand behind it and the thumb in front,



Fishing Nets.

as shown dotted in Fig. 4; hold it tight, and pass the point of the needle behind the loop in the direction of the arrows, forming the loop at C by a turn of the wrist. Then pass the needle in front of the first loop (see Fig. 4) and draw the knot tight by bringing the needle down with a sharp jerk; this will leave the knot as at A (Fig. 5). The knots B and C are made in the same manner, and a chain of meshes must be formed like this to the full length or width of the net. The knot A (Fig. 3) is then untied; this will bring the first mesh to the correct shape. Now, commencing from the end where the last mesh was made, turn the chain at right angles and place the last mesh but one (A, Fig. 6) on the hook and form a mesh at B; then place C on the hook and make a knot at D, and so on until a row of meshes the full length of the chain is formed: then work back again, and so on until sufficient netting is made for building up the form of net that may be required.

Enamelling Iron and Steel.—The process of enamelling iron and steel articles consists first in treating them with sulphuric acid to remove the dirt and dust. After drying, the articles are coated with the body or ground enamel which has been ground to a "slip" with water. When the enamel has dried, the articles are fired in a kiln so as to fuse the enamel and form a smooth, impervious layer. A second coating of cover enamel is applied and again fired in the kiln; this forms the outer surface. The enamels are all vitreous. A white ground is prepared by mixing together borax, 26 parts; powdered quartz, 8 parts; felspar, 32 parts; soda ash (pure), 8 parts; fluorspar, 2 parts; saltpetre, 1 part; and cryolite, 6 parts. These are melted in a clean crucible and finely powdered. For use, the ground frit is mixed with china clay in the proportion of 95 parts of the former to 5 parts of the latter. Another white ground consists of borax, 26 parts; quartz, 8 parts; felspar, 32 parts; soda ash, 9 parts; fluorspar, 6 parts; nitre, 3 parts; cryolite, 5 parts; and oxide of tin, 11 parts. This is fused, and 86 parts of it are mixed with 6 parts of clay and 8 parts of oxide of tin. Either of these recipes will make the ground for a porcelain enamel. A cover enamel may be made by melting together ground flint, 37½ parts; borax, 27½ parts; oxide of tin, 30 parts; soda ash, 15 parts; nitre, 10 parts; and magnesia, 7 parts. After fusing, grind with pulverised flint, 6 parts; oxide of tin, 3½ parts; soda, ¾ part; and magnesia, ¾ part. The coloured enamels are essentially the same, but contain a small quantity of one or more metallic oxides; for instance, cobalt for blue, chromium for green, iron for brown, etc. A metallic enamel may be made by diffusing precipitated copper through a colourless enamel. Glass enamel is obtained by fusing together borax, 32 parts; quartz sand, 20 parts; felspar, 28 parts; chalk, 9 parts; soda ash, 6 parts; nitre, 2 parts; oxide of manganese, ¼ part; and cobalt oxide, ¼ part.

Wire Rope Splicing.—In splicing six-stranded steel wire rope, the ends must be opened and the "lay" preserved as in making a long splice in hemp rope. The amount to be unlaid will depend on the size of the rope, but about twelve circumferences for each splice should be allowed; thus, if the rope to be spliced is 2 in. in circumference and six strands, 2 by 12 by 6 = 144 in., or 12 ft. Unlay 6 ft. of the ends of the ropes, and marry, cutting out the heart; then proceed as with a hemp rope long splice, following the lay of the strand opposite its partner as it is unlaid until the ends oppose each other 2 ft. apart. Next put a seizing round the rope on each side of each end, allowing room to tuck, which should be done carefully with the aid of spike, grease, and wooden mallet, using a hardwood block (considerably heavier than the mallet) to hold against the part hammered down. If the rope has to work over pulleys and the slight increase in diameter at each of the six splices has to be avoided, then commence with twice as much end and proceed as before, but when the twelve ends of the strands meet each other at equal distances and 4 ft. apart, halve the strands and make a long splice of each strand; by this plan there will be twelve splices of half-strands 2 ft. apart; the whole splice will occupy 24 ft., and if the seizings are attended to and the tucks snugged down, no increase in size will be noticed. Before cutting off the ends, put the rope on a strain with the winch and use the mallet and block freely, heave tight again, and repeat the hammering. The work is not easy for a novice, and requires great care, for if a tuck is crippled, or a strand sunk, before straining, no amount of hammering will put it right. The necessary tools are cutting pliers, a small sharp steel spike and two large steel spikes, riggers' screws, pincers, mallet and block, some nettlestuff for seizings, and a pot of grease, besides some means of straining such as steam winch or capstan.

Making Plaster Casts from Wax Moulds.—To make a plaster mould from a preparation manufactured of wax, the modelled work may be protected by brushing it over with soft soap which has been boiled in a little water. The plaster may then be poured over the modelling and separated from it without fear of damage. Plaster casts may then be taken from this mould in the usual way. To take a metal cast from a plaster mould the plaster may be mixed with an equal quantity of powdered pumice-stone.

Tanning Hides.—Horse and cow hides that are to be tanned must first be soaked to swell and soften them. This is usually done by placing the skins in an old lime pit and allowing them to remain for three or four days; then they are removed to a new lime pit and left for several days; altogether the liming takes about ten days. The lime is made by slaking quicklime and adding sufficient water to form a cream. The skins are then placed on a curved block of wood and the hair removed with a curved knife, the underside being dressed to remove the fat. The skins are then hung on poles and placed vertically in an old tan pit which has become acid. In this the lime gradually exudes, and a slight tanning is induced without closing up the pores of the skins. The skins are next placed one upon another in pits, dry bark or other tanning material being scattered between them and the tanning liquor run in. As a rule, several pits are used, the liquid being pumped from one pit to the other; at the same time, the skins are treated in rotation to a stronger tanning material until they have absorbed enough of the tannin, when they are removed and hung up to dry in a current of air. They are afterwards worked with an iron instrument to lay the grain and produce a smooth surface. From six to eight months is required for the tanning. There are newer methods which require a shorter period; for instance, chrome tanning (Series I., p. 34), and electrical treatment while in the tan pit.

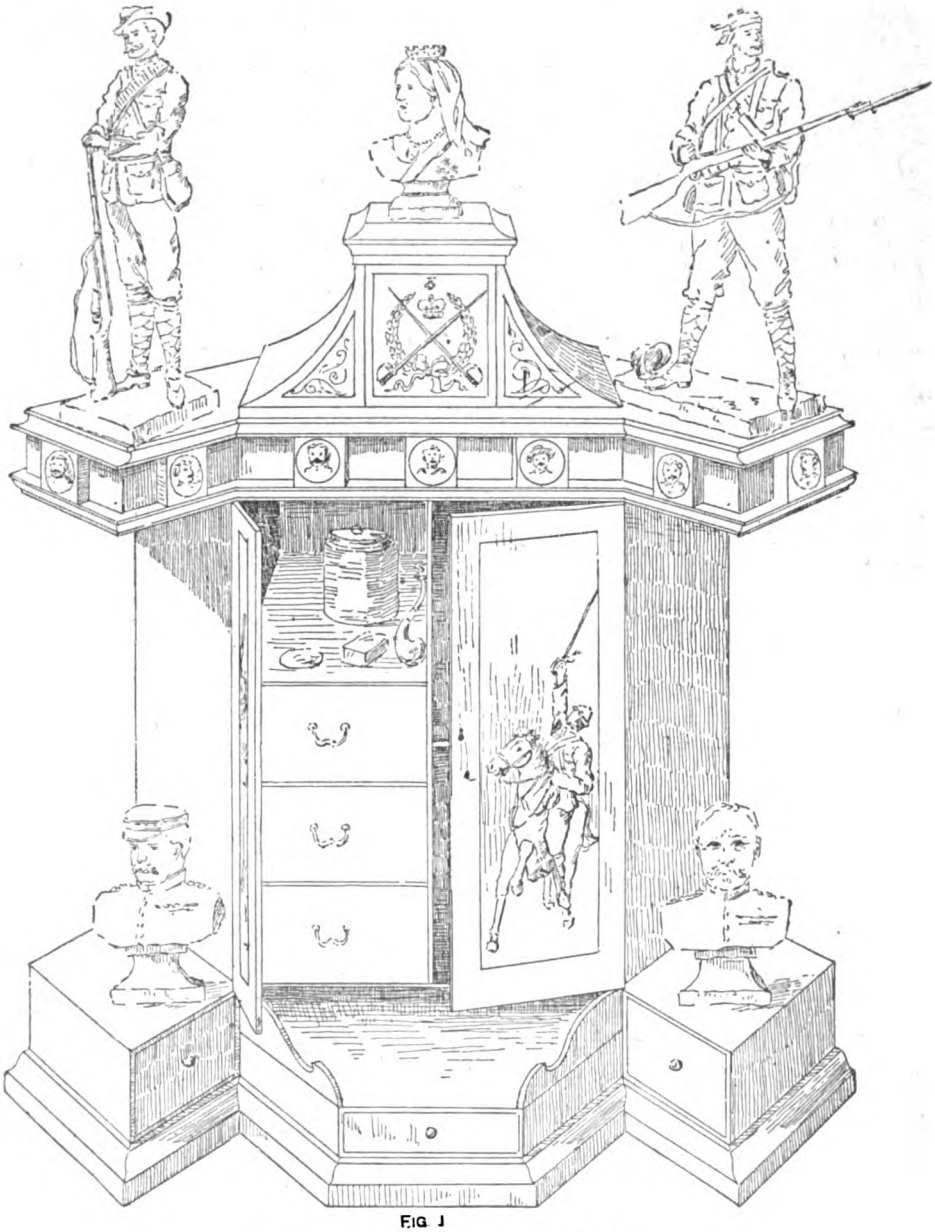


FIG. 1

Design for Smoker's Corner Cabinet.

Design for Smoker's Corner Cabinet.—Fig. 1 is a perspective view and Fig. 2 (p. 79) a plan at the base of a smoker's corner cabinet of a patriotic design. From the

plan it will be seen that the cabinet will not quite fill a corner and that there is a triangular space at the back. The elevation shows on the left side three drawers, over which is a shelf where tobacco jars, ash trays, matches, etc., may be placed. At the back or side of this upper space a pipe-rack may be fixed. On the right-hand side more drawers may be fixed, though this space may be utilised for holding bottles. The middle bottom drawer may be divided into compartments for cards, markers, counters, etc. On the panels of the doors may be drawn, or taken from illustrated periodicals, scenes from wars, etc. The dentels along the cornice may be ornamented by button portraits of different generals.

Burning Clay for Ballast.—The burning of clay to make ballast in parts of the country where broken stone and broken bricks are not so easily obtained is carried out by the following method. The clay is dug over and mixed, so as to make it as much as possible of one consistency, and is left exposed to the air for a few days to dry. To form the heap two or three stout pieces of waste timber are stood upright, and a horizontal flue is constructed with bricks laid without mortar, or of drain pipes. The inner end of the flue is at the centre of the heap, where the timbers stand; the outer end of the flue is at the edge of the heap, say two or three yards away. A pile of firewood and shavings is now made round the centre posts until a conical heap is obtained, say 4 ft. high, and 6 ft. or 7 ft. wide at the base. On the wood about half a ton of coal is laid, and over the coal the clay is deposited in a layer of about 6 in. thick. Now with a long rod push through the flue;

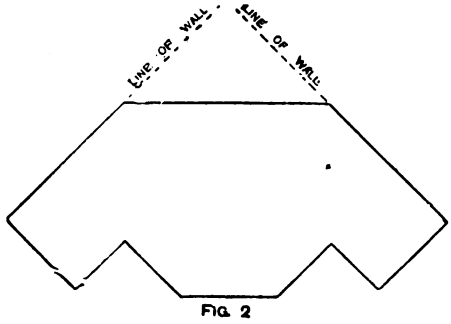


FIG. 2

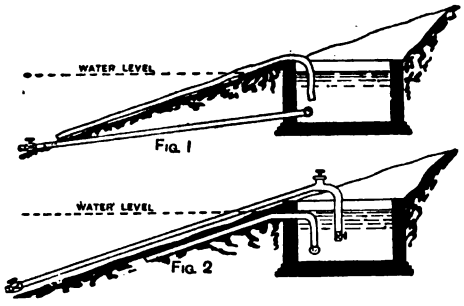
Design for a Smoker's Cabinet.

a flame is applied to the shavings in the middle, and the fire is started. The timber in the middle sets the coal ablaze, and the draught through the flue assists combustion. When the whole heap has become incandescent more coal is added on top of the clay, and another layer of clay applied over the burning coal. This process is repeated until the heap becomes too large to get at easily, when it is left to burn out, and the clay should then be found burnt hard like brick. It will require breaking up. A cubic yard of clay, measured in the solid before digging, will measure about a yard and a half when burnt, and will weigh about a ton. As to the amount of coal required, it is stated that ½ cwt. to 1 cwt. of coal is required for each yard of clay, or, according to another authority, 100 cubic yards of clay will require 4 tons of coal and 11 cubic yards of breeze.

Cement for Repairing Jet Brooches.—Ordinary shellac, bought in flakes, is employed as a cement for fastening metal backs on jet brooches. To use it, first run the shellac on the metal, then warm the back of the brooch by holding it near a flame, and heat the metal again until the shellac runs. While both are hot, bring them together and press well.

Staining Veneers for Inlaying.—Aniline dyes, which may be procured in many bright colours, are useful for staining veneers to be used for inlaying; the dyes should be dissolved in common malt vinegar and applied hot. Several applications may be necessary, in order that the stain may penetrate sufficient to stand the levelling down for polishing. A blue stain can be made as follows. To each gill of aquafortis add ½ oz. of copper fillings. Apply hot, then brush over with a solution of pearlash—4 oz. to 3 pt. of water. If possible, the wood should lie in the solutions for several hours. Another blue stain can be made by dissolving china blue in vinegar. Indian indigo dissolved in arsenious acid also yields a powerful dark blue. For a green stain, apply a hot solution of verdigris in vinegar. Another green stain consists of 1 oz. of Roman vitriol, 1 qt. of boiling water, 1 oz. of pearlash, and 1 oz. of yellow arsenic. For a black stain, boil in an old iron pot till dissolved 1 gal. of vinegar, 2 lb. of extract of logwood, ½ lb. of green copperas, ½ lb. of china blue, and 2 oz. of nut galls; then add ½ pt. of iron solution, made by steeping a handful of rusty nails in each ½ pt. of vinegar. Another black stain can be made by boiling 2 oz. of extract of logwood, 1½ oz. of copperas, and a dash of china blue or indigo in 1 qt. of water. Apply hot, then give several applications of iron solution. For satin-wood stain, take 1 qt. of spirits, 3 oz. of turmeric, and 1½ oz. of gamboge. For a purple stain, take ½ lb. of logwood extract, ½ lb. of pearlash, 1 oz. of indigo, and 2 qt. of water, and boil till the full strength is gained. It is a good plan to fix the dyes or stains by means of a mordant, such as clear ox-gall, which may be applied with a brush.

Syphon Attachment to a Manure Tank.—A liquid manure tank, say 6 ft. square and 4 ft. deep, can be emptied by a syphon if the adjacent ground falls away from the tank, and providing that the outlet end of the syphon is lower than the level of the water that is to be syphoned. In order to start the action there must be some means of filling the syphon. A leather hose-pipe, say 2 in. in diameter, could be used, as shown in the upper part of Fig. 1. The pipe should be first filled with water, then one end of the pipe plugged and dipped down into the liquid manure. On pulling out the plug and taking the other end of the hose pipe to any point below the top level of the liquid in the tank, the flow of liquid would commence. If it is required to fill the manure into a tank-cart, and the inclination of the ground continues to be, say, 1 in 8, about 10 yd. of pipe

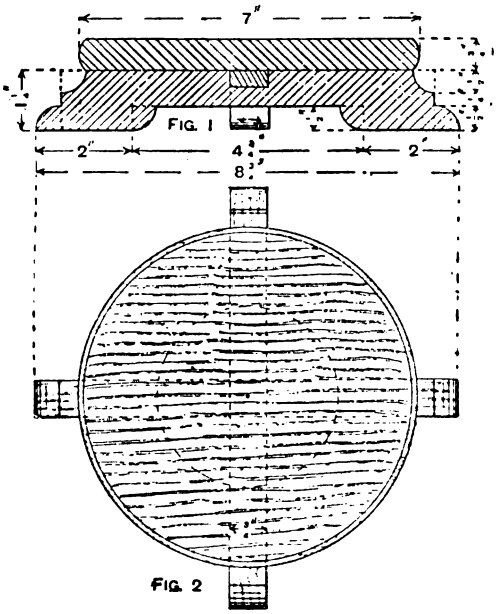


Syphon Attachment to a Manure Tank.

will be required. The lower part of Fig. 1 shows a simple draw-off or drain of 2-in. wrought-iron tubing, with a rose or strainer inside the tank and a stopcock at the outlet end. This draw-off would always be in working order, and if there is a good fall available the pipe need not be very long. Instead of the leather hose, a permanent iron syphon of 2-in. wrought-iron pipe can be fixed, as shown in the upper part Fig. 2. A stopcock will be required at the outlet to regulate the discharge, and, in order to start the syphon, another stopcock will be required under the water level in the tank, and also a short branch pipe, which must be provided at its highest point with a screw-down valve that must be air-tight. When this syphon is first put into use the two end stopcocks must be closed, and water poured in at the branch pipe until the whole length of the syphon is filled with water; the screw-down valve is then closed, and when the stopcocks are opened the flow of liquid will commence. If care be taken not to let the level of the liquid in the tank be lowered so much as to permit air to be drawn into the syphon, the syphon will remain full of liquid when the bottom stopcock is closed, and will be ready for use at any time. After the syphon has been in use for some months it may be found that air from the liquid has accumulated in the bend of the pipe. In such a case water must be poured in at the branch pipe, first closing both stopcocks as before described. In the lower part of Fig. 2 is shown a method by which the syphon can be made to fill itself. The apparatus is built into the tank at such a level that the liquid in the tank will rise high enough to fill the syphon, that is to say, the syphon will act as an overflow, and, if permitted, will continue to act until the liquid is lowered to the level of the strainer or the syphon inlet. By means of a stopcock on the outlet end of the syphon just as much of the liquid can be drawn off as is required, and the syphon left ready for action. If the syphon should accidentally run dry it can be started again by filling the tank.

Re-mounting Photographs.—Soaking in water is the only satisfactory method of removing a print from a mount, and although soaking for an hour or two will not seriously affect the print, the mount will of course be spoilt. If the print is an albumen print, it is better to soak it in warm water. This may also be used for a gelatine print if the print is first immersed in a 5-per-cent. solution of formalin. The proper mountant for photographs is starch, made in the usual manner by crushing and dissolving the starch in cold water and adding boiling water till the starch thickens. The starch is mixed as if for use in laundry work. Glenfield starch is generally preferred by professionals. Great care must be taken to avoid lumps. If in doubt, squeeze the starch through muslin before use. Starch must be fresh made or the photographs will fade. The addition of a few drops of formalin will serve to preserve the starch for a few days.

Stand for Teapot or Flower-pot.—Fig. 1 is a section of a teapot or flower-pot stand, and Fig. 2 is a plan. The top, ¾ in. thick, is circular, and the edge is rounded as shown in section; the shape of the two feet, which

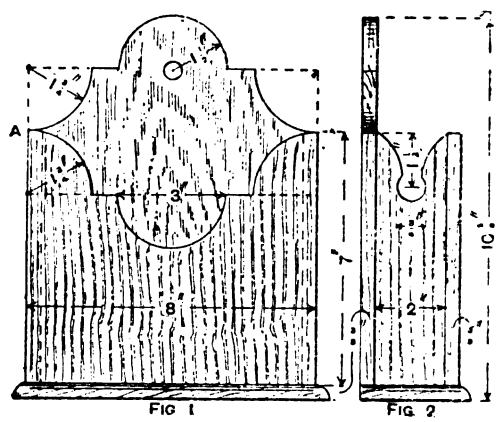


Stand for Teapot or Flower-pot.

are joined together by a half-lap joint, is illustrated by Fig. 1. As a variety, an oval top might be used, and in that case, of course, one foot would be longer than the other.

Acetylene Lamps for Bicycles.—The following remarks on acetylene lamps for bicycle use are on the authority of Prof. Lewes, who says that though the wonderful illuminating power of these lamps enables the rider to have a clear view of a considerable distance of the road ahead, this is not of advantage alike to the rider and to the pedestrians and the drivers of nervous horses, as the rapid passage of so brilliant a beam of light leaves the eye incapable of discerning surrounding objects for some few moments after the cyclist has passed. The acetylene cycle lamp costs more to buy and to maintain and is heavier than the oil lamp. There is the trouble and smell of recharging, and the whole of the charge must be used at once, as it is impossible to stop the flow in so small a mass of material, and the only safe way is to allow the lamp to burn itself out. Unless it is heavy and clumsy, its charge will last only four to four and a half hours, whilst in winter a six-hours' light may be wanted. The granulated carbide used in these lamps largely decomposes during granulation, and gives but a low yield of gas. The requirements of an acetylene cycle lamp, according to Prof. Lewes, are the following. The charge should be capable of being varied in amount, so that carbide, either for a short period or for a maximum of six hours' generation, can be put in; the lamp should not require regulation after having once been lighted, or, at any rate, the regulating tap should be so situated that the rider can adjust it without dismounting; the carbide should not shake in the lamp, but yet room should be provided for the lime formed; it should be possible to extinguish the lamp without any great after-production of gas; the gas should be filtered through such material as silicate wool before being burnt in order to guard against water vapour and lime dust being carried forward and choking the burner; the lamp should be constructed to work with other forms of carbide beside cartridges, as otherwise, when these cannot be obtained, the lamp is useless; the reflector should be curved so as to reflect the greater part of the light immediately in front, a small portion of the light being concentrated into a beam to illuminate the road some distance ahead; the burner must be of steatite, and whether plain jet or flat flame should be made on the air-injector plan; there should be provision for cleaning the burner in case of stoppage by means of the cycle pump; a lamp in which a wick sucks or syphons water to the carbide is not good, the cotton soon becoming choked with lime and losing its capillary powers; the charging and cleaning of the lamp should be made as simple as possible, the whole of the interchangeable parts being made to take to pieces.

Brush and Comb Box.—The brush and comb box shown in Figs. 1 and 2 may be made of ⅜-in. wood. A piece 14 in. long and 8 in. wide will make the back and front. The point A (Fig. 1) will be 7 in. from one end,



Brush and Comb Box.

and by sawing out with a fret-saw the back and front are shaped at one operation.

Silver-plating without a Battery.—As silver-plating without a battery is done by the chemical substitution of silver for metal dissolved from the articles being plated, it is clear that such a thick and firm coat of silver cannot be put on by this method of plating as by the electro-plating process. One of the best processes for silver-plating without a battery is that invented by M. Roseleur. The solution is formed as follows. Dissolve 4 lb. of washing soda in 5 pt. of distilled water and place in a vessel furnished with a bent glass tube connected by a rubber pipe to another vessel constructed to generate sulphurous anhydride gas. Pass this gas through the soda solution until the crystals first formed are all dissolved and the liquid slightly reddens litmus paper; then set aside for twenty-four hours. Next stir well, and test for acidity. The liquid should slightly redden blue litmus paper. Pass more gas if too alkaline, or add more soda if too acid. Then stir in enough silver nitrate to take up nearly all the solvent, ceasing to stir in the silver when it dissolves slowly. This will deposit thick coats of pure silver on well-cleaned copper, brass, and bronze articles; but it also deposits its silver on the sides of the vessel in which it is contained. Its metal is renewed by occasionally adding some nitrate of silver solution and some bisulphite of soda. This solution is used cold. Another solution, to be used boiling hot, is made as follows. Dissolve 10 oz. of silver nitrate in 5 pt. of distilled water, then add 60 oz. of potassium cyanide dissolved in hot distilled water. These solutions will only silver copper and its alloys, and but thin films of silver can be deposited from them, because deposition ceases when the articles are coated with silver and thus protected from the chemical action of the solvent contained in the liquid.

Preventing Wooden Tank Leaking.—If the leak in a wooden tank is due to bad construction, it will be advisable to take the tank to pieces, groove and tongue all joints between the boards, fix outside stays to the sides and ends, and brace the tank together with iron tie-bolts. Then give an internal coating of pitch, which would not only make the tank water-tight, but would also prevent the wood shrinking and keep the joints from opening when the tank is partially emptied of water. Another method of stopping the leak would be to fix deal fillets over all joints and in all angles. The fillets must be bedded in oil cement and fixed with screws.

Child's Rocking Cot.—Accompanying this is an original design for a child's cot and stand with a cupboard. The arrangement has three important features, namely safety from tilting, ease in rocking, and noiseless action. Fig. 1 shows the front elevation. The cradle is held in position by four coil springs, which reduce the energy expended in rocking the cradle to a minimum. The rockers should be lined with felt to prevent noise. Fig. 2 shows the end elevation, and Fig. 3 the plan. The cradle may be taken off the stand simply by detaching the springs, and the stand, when not in use, may be slid under the bed. Fig. 1 shows the cupboard

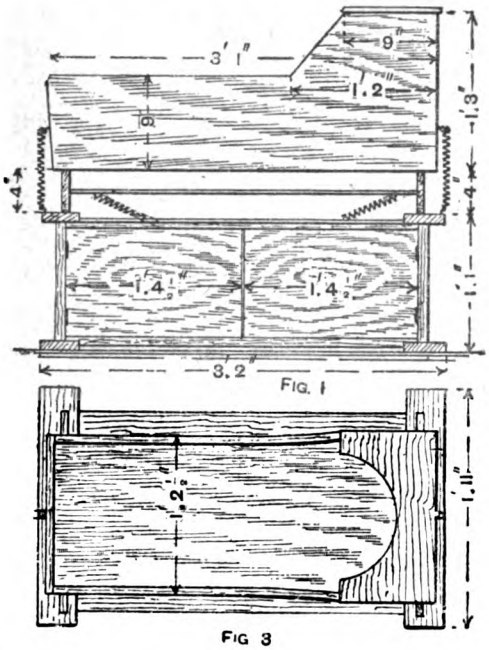


FIG. 1

FIG 3

doors, which open from the centre and are fixed by hinges at each end. The head of the cradle is made similar to the form used a century or more ago. On completion, the woodwork is stained with venetian red mixed with glue size; give the outside parts one or two coats of shellac varnish.

Acetylene Gas Installations.—"The success of an acetylene installation," says Prof. Lewes in "Acetylene," the standard work on the subject, "largely depends upon the way in which the fitting is done. In putting up an ordinary installation for a house a non-automatic generator should be employed, and a holder capable of containing sufficient gas to last the whole evening with the maximum number of lights burning. The generator and holder should both stand perfectly level upon a firm foundation, preferably of brick or concrete, and all pipes should have a slight fall back to the holder. The generator and holder, according to regulations, must be a short distance from the house, and a building containing them must be well ventilated, and capable of being warmed by hot-water pipes in cold weather, so as to prevent freezing of the water in the holder and in the generator system. Where this is not practicable, the holder tank must be filled with a solution of brine, in which case all iron work. . . . must be carefully coated with a good protective paint. The specific gravity of acetylene being 0·9 as against 0·4 of ordinary coal gas, the flow through the pipes is rather less; but inasmuch as less than one-fifth the volume of acetylene is required for each burner that is employed than for coal gas, this factor may be disregarded. A pipe of a given size may be taken as supplying three times as many burners as would be the case if coal gas were used. In ordinary installations the following sizes of pipes may be employed, and in no case should pipes smaller than ⅜ in. be used.

⅜	in. pipe	up to	8	burners.
½	,, ,,	,, ,,	15	,,
¾	,, ,,	,, ,,	60	,,
1	,, ,,	,, ,,	100	,,
4	,, ,,	,, ,,	2,000	,,

In house-fitting no composite pipe should be employed for acetylene, the best iron barrel only being used, and the joints should all be well-cut right and left-handed screw unions. No packing or paint must be used in making the joint, but the threads may be dusted with finely ground plumbago. The reason is that tar, paint, and all the usual substances used in making joints with coal gas are rapidly acted upon by acetylene, becoming brittle and cracking, thus giving rise to leakage. The taps must be of the best brass, such as are used for water and steam work, with full taper plugs in deep barrels, so as to give plenty of grinding surface, the ordinary cheap brass fittings rapidly becoming leaky."

Repairing Vulcanite Plate for Artificial Teeth.—A broken vulcanite plate on which a set of artificial teeth is mounted can be repaired in the following way. Over a small gas jet melt a piece of wax and drop it slowly on the polished surface of the broken plate, at the same time holding the two parts together; cool in water, mix about two tablespoonsful of plaster-of-Paris, and with this cover the unpolished side very thickly, so as to have a deep model. When the plaster has set, trim around the teeth so as to take the set easily from the plaster; then pour boiling water over the teeth to clear away the wax. Now serrate the edges

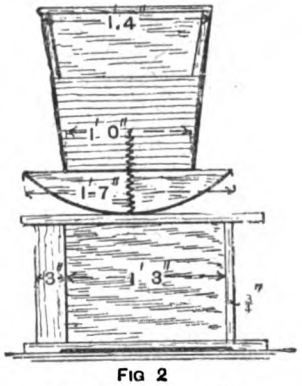


FIG 2

Child's Rocking Cot.

of the fracture with a small half-round file, and scrape the surfaces at the edge so as to get a clean joint. Oil the model, place the teeth on it, drop some wax to replace that which has been filed and scraped away, cool under a water tap, and trim the wax smoothly. Mix about three times as much plaster as before, pour it into the lower part of the flask, plunge in the teeth and cover all except the wax, smooth the plaster level with the sides and allow a quarter of an hour for setting, then oil and wipe the surface. Mix the same quantity of plaster as before, fill to the top of the flask, pour a little plaster on the wax, press the bottom part of the flask into place on the top part, and allow to set: cut away the plaster that has been pressed out, slightly warm in an oven, open slowly and carefully with a knife blade, run the wax out with boiling water, and when clear put back into the oven to get hot (not too hot). On a plate placed on a basin of hot water, cut up the rubber (about a square inch should be sufficient) into squares, from ten to fifteen to the inch, and with a blunt darning needle pick up a small piece and press it carefully into the spaces previously occupied by the wax. Pack a little more rubber than is sufficient to fill so as to have a little surplus, close up the flask, squeeze tightly in a clamp, put into the vulcaniser, and bake at 315° F. for seventy-five minutes. Allow to cool for half an hour, then take out and carefully cut away the plaster with a knife, wash with a nail brush, scrape the repair evenly, glass-paper smoothly and polish on a lathe with a brush and superfine pumice powder, and polish with fine chalk.

Dissolved Acetylene.—Prof. Vivian Lewes has given some important particulars of the solvent powers on acetylene of boiled water, saturated salt solution, olive oil, acetone, and a number of other liquids. Dissolved acetylene is but a recent commercial application. It appears that the solubility of a liquid increases nearly in proportion to the pressure exerted on the liquid. Prof. Lewes says, "Claude and Hess noticed in 1897 that 1 volume of acetone at 15°C. and under ordinary pressure dissolves 25 volumes of acetylene, and under 12 atmospheres 300 volumes. . . . The solubility in acetone is diminished by half on passing from 15° to 50° C.; and therefore the pressure in a reservoir doubles for a rise of about 30°. With liquid acetylene a pressure of 24 atmospheres increases to 70 for a rise of 18°. Dissolved acetylene may, therefore, be stored safely in weaker and lighter vessels than liquid acetylene; and since its co-efficient of dilatation is very much lower, the vessels may be more nearly filled. A platinum wire, maintained at bright redness by electric current, was held for an indefinite period with impunity in a solution of acetylene in acetone made under a pressure of 3 atmospheres."

Collapsible Canvas Boat.—Figs. 1 and 2 show a collapsible dinghy 6 ft. long by 3 ft. 6 in. broad by 1 ft. 6 in. deep, double ended. The keel K (Fig. 1) is of oak, 2 in. by 1½ in., and the oak stem- and stern-posts are 3 in. by 1¼ in. The rubbing piece R outside the keel is 1 in. by 1¼ in. broad, of rock elm. The stringers S should be of oak 1½ in. by 1 in., and those marked S' 2 in. by 1½ in. All these should be cut out of the solid to the proper curve, having the fibre of the wood running with the shape, otherwise they must be carefully bent to shape after steaming. They are hinged to the stem- and stern-post as shown at Fig. 2, H being the hinge. The

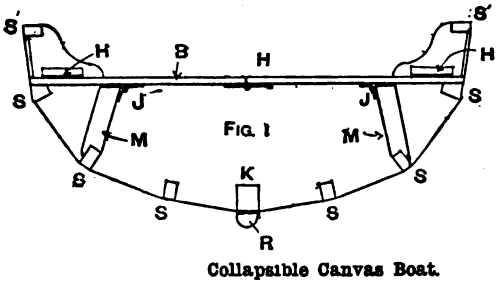


FIG. 1

Collapsible Canvas Boat.

thwarts B (Fig. 1) are of 6-in. by ¾-in. teak, and hinged at H. An elm knee crook is fitted and hinged as shown, to support S' when rowing. The thwarts are kept up by means of the two struts M, of 2-in. by 1-in. rock elm, hinged to the thwart at J; these can be easily jerked into position when the boat is to be used. Floor boards ¾ in. thick may be stretched across on the two lower stringers. Note that the thwarts are permanently fixed to the stringers S. Use No. 6 canvas, giving it four coats of oil paint. The thwarts and stringers may be varnished, and all the hinges should be of brass, with gunmetal pins.

Portland Cement.—Portland cement, extensively used in many building operations, is a combination of carbonate of lime and fine clay, producing a double silicate of lime and ammonia, and consists of a chemical combination of lime, silica, and alumina, with iron in certain well-defined proportions, together with alkalies, magnesia, etc. The lime may vary from 58 to 64 per cent., the silica from 18 to 24 per cent., and the alumina and iron from 8 to 14 per cent., the three together amounting to about 95 or 96 per cent. of the whole.

Making Coal Briquettes.—To make briquettes from coal dust, procure an old iron boiler, similar to those employed in boiling asphalt for street paving. The coal dust that is to be converted into briquettes must be boiled along with coal-tar pitch in the proportion of 20 lb. of pitch to 1 cwt. of dust. The mixture must be well boiled, so as to thoroughly blend together the two ingredients. When the mixture is ready it is taken from the boiler in convenient portions and beaten with wooden bats and so moulded into blocks; sometimes the blocks are beaten and afterwards dried in wooden moulds. Another method which is sometimes employed does not require any boiler, liquid coal-tar and water being mixed with the coal dust. The coal dust is gathered into a heap, a hollow scooped out in the centre, and into this hollow the liquid coal-tar, with or without the addition of water, is poured. The mixture is then worked up with a shovel (in the same way as mortar). When the mixture has attained the consistency of a dry paste that will hold firmly together, a small portion is taken from the mass and well beaten with a short-handled, broad, square wooden bat, until the mixture becomes a close and compact solid, when it is either formed into a brick with the bat or rolled into the shape of a ball, say about twice the size of a cricket ball. The balls are then set out a little apart from each other to dry, or are piled in open heaps like shot, so that the air can freely circulate round them. The briquettes should be allowed to dry for a fortnight or more, as may be required. The liquid, if diluted, should have at least 2 parts coal tar to 1 part water.

Blueing Watch Screws.—Watch screws are blued by heat. First polish the top of the head, then take a strip of thin sheet brass in which are a few holes of assorted sizes. Place the screw standing up in one of the holes, with the head resting on the brass. Then slowly heat it over a spirit lamp flame. The polished surface first turns a straw colour, then red, then dark blue. Immediately this appears, tip off the screw.

Gas Heater for Small Bath.—A bath heater similar to the accompanying sketch consists of a tin or copper vessel holding about 5 gal. or 6 gal., with a conical flue-way up through it, the heat being furnished by a 6-in. double-ring gas burner beneath. The size would be about 2 ft. high by 10 in. in diameter, with a 2-in. outlet at the top. A pan must be placed beneath, as the water contained in the products of combustion from the gas will be condensed and will drip down from the conical

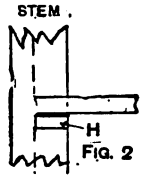
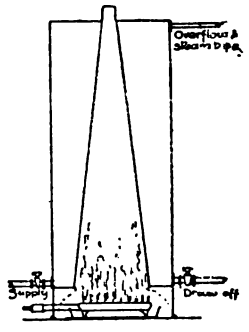


FIG. 2



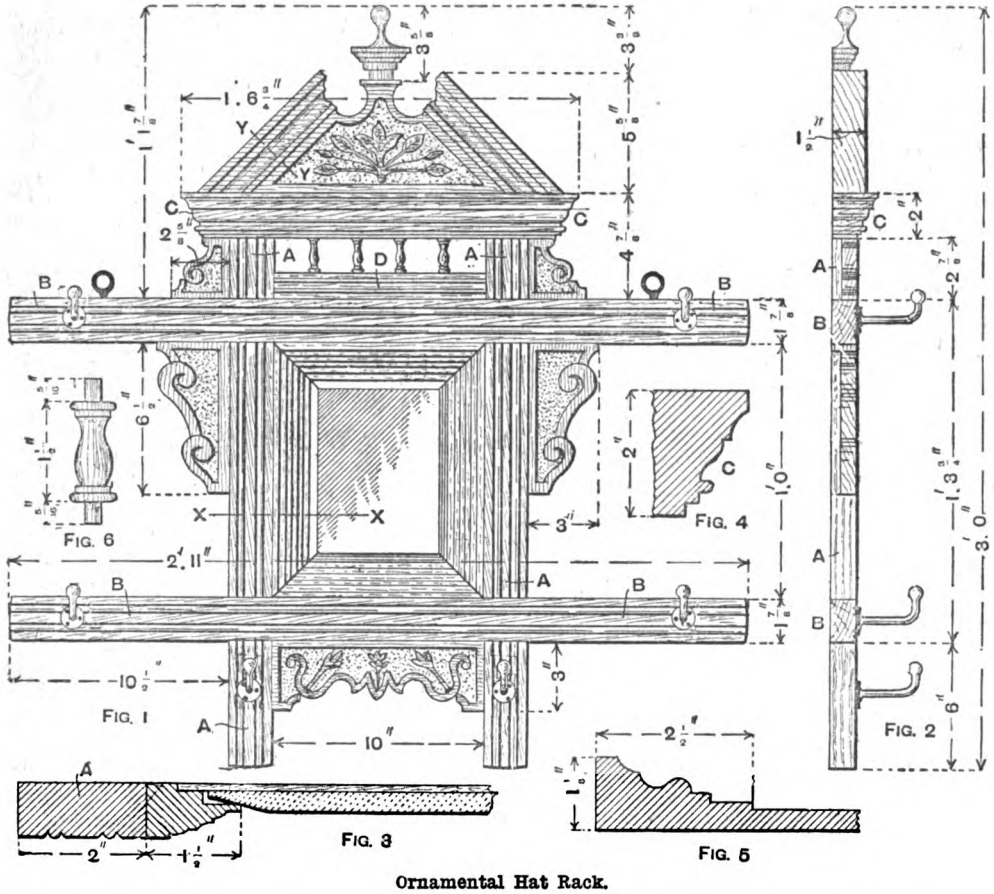
Gas Heater for Small Bath.

flue-way. There must be an overflow pipe to indicate when the tank is full, and this will answer for an air and steam pipe. The products of combustion should be carried to a chimney by a pipe, unless the room is a large one. If desired, a water gauge could be put on the side of the tank.

Wood-block Floors.—Wood-block flooring has been very much in favour for many years, and has been and is still extensively used for hospitals, infirmaries, schools, and public buildings generally. The bed in which the blocks should be laid is prepared as follows. A foundation of Portland cement concrete is put down and allowed to dry for a few days. Screeds of Portland cement, about 3 in. wide and ¾ in. to 1 in. thick, should be then formed round the floor space, about 6 in. from the walls and intermediately where necessary. These screeds should be levelled and made true with straight rules; then the spaces between the screeds should be floated with Portland cement. This should be allowed to dry and then be coated with boiling Stockholm tar. The blocks, which should be of good and sound seasoned timber, and baked before being used, should be dipped into hot tar or mastic asphalt to about half their thickness, and then laid. Mastic asphalt or cement for laying wood block floors is made of powdered asphalt and mineral tar in the proportion of about 100 asphalt to 1 of tar, to which sand is added in proportion as required. These ingredients should be heated in a cauldron, and the mixture constantly stirred until the different substances are thoroughly incorporated. Various devices are adopted for holding the blocks together, such as dowels, grooves, tongues, etc. There are several systems on the market, similar to the above but differing in detail. Wood-block floors, when properly executed, are one of the best forms of floors, being warm, solid, non-slippery, durable, free from foul air, vermin, damp, etc., and if kept properly clean are the least dangerous to health.

Paint to withstand Heat.—To mix black and green paint to withstand steam heat, take ordinary black and green paints ground in oil and thin them with best copal varnish and a little turpentine, if necessary. Another and better method is to have the dry colours ground in copal varnish and thin with turps; in this way enamel paints yielding a high gloss are obtained. Still another plan is to mix the colours ground in oil with turpentine only for thinning, so as to form a "flatted" surface, and then to give two coats of pale copal varnish.

Ornamental Hat Rack.—The ornamental hat rack illustrated by Figs. 1 and 2 looks well if made of ¾-in. or 1-in. walnut. It consists of two stiles A, 2 ft. 2⅝ in. long, and two rails B, 2 ft. 11 in. long, all being ⅞ in. thick and 1½ in. wide, and halved together in the position shown in Fig. 1. In the centre of the



Ornamental Hat Rack.

stiles and rails an inner frame of 1½-in. moulding is fixed with nails driven slantwise, leaving a space for the mirror 10 in. deep and 7 in. wide. The bevelled mirror rests in a rebate and is secured with a backboard, as shown in Fig. 3, which is a section on line X X (Fig. 1). On the top of the two stiles an ornamental cornice C, 2 in. deep, is fixed. This may be made in three pieces 1 in. thick mitred together, or in one solid piece, 2 in. thick. Fig. 4 is an enlarged section showing the shape of the cornice moulding. A pediment 1¼ in. thick is fixed on top of the cornice, and the inner portion is sunk with the exception of an ornamental relief. Fig. 5 is an enlarged section of the pediment on Y Y (Fig. 1). In the four corners formed by the top rail and the two stiles ornamental brackets are fitted. The top brackets are 2⅞ in. deep and 2⅝ in. wide, and the bottom brackets 3 in. wide and 6½ in. deep, all being ⅛ in. thick. At the bottom an ornamental piece 3 in. deep, 10 in. wide, and ⅛ in. thick, is fixed. The brackets and the ornamental bottom piece have sunken centres with raised ornament. A rail D is let in at the top as shown, and four turned spindles (Fig. 6) are dowelled in. The rail can be omitted if desired and longer spindles used. Two strong eyes are secured to the top rail for hanging purposes, and six brass hat pegs fixed in the positions shown in Fig. 1.

Acetylene.—According to Prof. Vivian Lewes' standard work on acetylene, the original discovery of this gas is due to Edmund Davy, Professor of Chemistry to the Royal Dublin Society, and it was at a meeting of this body in March, 1836, that he first described some of its more important properties, whilst in the autumn of that year he introduced his discovery to the British Association at their Bristol meeting. "Edmund Davy, in 1836, named the newly discovered gas (acetylene) bicarburet of hydrogen, to mark the fact that he supposed it to be 'composed of two proportions of carbon and one of hydrogen'; whilst later the name 'klumene' was bestowed upon it, because it had been derived from a kalium compound potassium carbide." The name "acetylene" was given by Berthelot "from the fact that it bears the same relation to the radical acetyle, C_2H_3, that ethylene does to the radical ethyl, C_2H_5." "The ratio of carbon to hydrogen in acetylene is as 12 to 1, and the density of the gas at once shows that the molecule must be represented by the formula C_2H_2. It has a molecular weight of 26, and density 13." "The specific gravity of the gas, as found by Berthelot, was 0·92, whilst the determinations by Moissan gave 0·907 and 0·912 respectively, the theoretical figure being 0·8985, and one litre weighs 1·165 gr. at 0° C. and 760 mm. pressure." "Acetylene occurs in minute traces in coal gas, and all other gases produced by the destructive distillation of organic matter containing hydrogen and carbon, whilst it is invariably found in the interior of all hydrocarbon flames." "It is a clear colourless gas, having a sweet ethereal odour, the unpleasant smell noticeable in the gas as ordinarily prepared being due to impurities, and disappearing as soon as the gas is purified."

Retouching Medium for Photographic Negatives.—Ordinary resin dissolved in turpentine has been found perfectly satisfactory both as regards tooth and freedom from disturbance when varnishing. Some workers—probably owing to some difference of touch—experience difficulties in using it. Samples of resin vary, and if any particular kind gives trouble it should be at once discarded and a fresh sample procured elsewhere. The exact consistency of the medium depends entirely on the artist's touch. The medium should never be so thick as to be tacky in printing. Workers with a light touch, who use a soft pencil, use the medium in the form of thin syrup which, rubbed vigorously over the negative, imparts a polished surface; others prefer a thinner medium. A mixture of pale resin 1 part, oil of lavender 2 parts, and oil of turpentine 1 part, is a good medium.

Hanging Door with a Rule Joint.—A door, with a serving board 7 in. wide, having a rule joint on the hanging stile, will have the same kind of joint in the serving board. Fig. 1 is a plan showing the serving board and joint; the dotted lines show the door below. Fig. 2 is a section through the door and serving board, showing a bracket fixed on the inside of the door to support the board. Before making the rule joint, get the brass back flap hinge, take the distance from the face to the centre of the pin, and mark on the end of the stile; this will be the centre from which to strike the radius of the joint as shown. The position of this centre must be found on the serving board by squaring across from the edge. Measure exactly how much the board overhangs the door, and to this add the distance the centre is from the face of the door; the sum of the two will give the striking point, and the radius will be 4¾ in. The brass back-flap must be let in very carefully

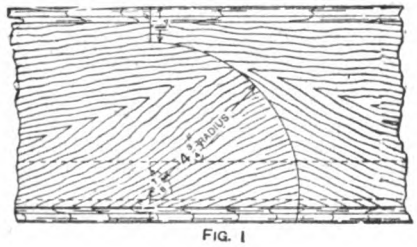


FIG. 1

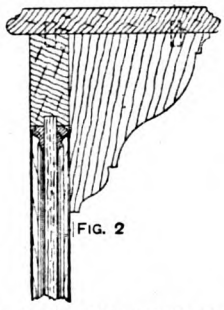


FIG. 2

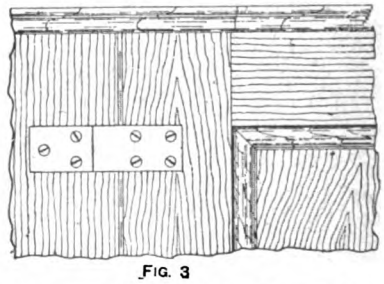


FIG. 3

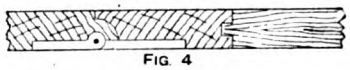


FIG. 4

Hanging Door with a Rule Joint.

flush with the face, and the centre of the joint-pin kept to the striking point of the circle (see Figs. 2 and 4).

Loosening Slides of Tenor Horn.—To loosen the slides of a tenor horn which have become fixed, put a little paraffin oil round the joints of the slides and let it lie on till it oozes in. Clean off the superfluous paraffin and apply heat by means of a spirit lamp or Bunsen burner, taking great care not to loosen the brazing of the joints. Blowing through the instrument will help to keep it cool inside and prevent the inner tubes from expanding as much as the outer. When a good heat is on, pass two or three turns of soft cord round the U-shaped ends of the slide, fix the ends of the cord in a vice, and give a steady pull. Afterwards rub on a little tallow or vaseline to prevent the slides again sticking. The above instructions apply in general to loosening the slides of all brass wind instruments.

Risks of using Compressed Acetylene.—The effects of shock on cylinders charged with compressed acetylene or liquid acetylene is a subject that has been dealt with authoritatively by Prof. Lewes, and his words may be quoted to show that the danger from shock when using vessels charged with acetylene gas is practically nil; with the liquid acetylene, the danger is but very slight; in practice there should be none. He says, "We have submitted to shock—either by allowing them to fall from a height or by blows from a hammer—steel cylinders of about 1 litre capacity, charged, some with gaseous acetylene compressed at 10 atmospheres, and others with liquid acetylene, at a charge density of 0·3—3,000 gr. to the litre. (1) Repeated falls from a height of 6 metres on to a massive steel anvil gave rise to no explosion. (2) The crushing of the same receivers under a hammer of 280 kilos. falling from a height of 6 metres, produced neither explosion nor light in the case of gaseous acetylene under a pressure of 10 atmospheres. With liquid acetylene in the experiment, the shock was followed after a short time by an explosion. This phenomenon appears attributable not to the pure acetylene, but to the ignition of the explosive mixture of acetylene and air formed in the moment of time which follows the rupture of the cylinder. The ignition is no doubt brought about by the sparks produced by the friction of the edges of torn metal. (3) A cylinder of wrought iron containing gaseous acetylene under a pressure of 10 atmospheres, bore without explosion the impact of a bullet which had sufficient velocity to pierce the front and dent the back of the cylinder."

Preserving Wasps' Grubs.—Wasps' grubs are sometimes preserved for winter use. The plan of baking in a slow oven, or in bread, hardens the skins and preserves them, but only for a few days. Placing them in an alcoholic solution will preserve them indefinitely, but they would not be suitable for birds' food, though they might perhaps answer for fish bait. Immerse some in each of the following, and keep to the most suitable. (*a*) Methylated spirit. (*b*) Methylated spirit, 1½ pt.; distilled water, ½ pt.; burnt alum, 2 oz.; and saltpetre, 4 oz. (*c*) Benzoline. (*d*) Rock salt, 4 oz.; saltpetre, 4 oz.; carbolic acid, 1 oz. (or a tablespoonful); and water, 1 gal.

Making Artificial Teeth from Ivory.—A few notes on cutting and fitting artificial teeth made from ivory are given below. Assuming the patient has a clear upper jaw—that is, devoid of teeth—a block of ivory, half oval in shape, 2½ in. by 1½ in., about 1 in. thick, and hollow at the heel, must be procured. Paint the roof of the patient's mouth red, carefully insert the ivory in the mouth, and press gently and accurately to the painted jaw; withdraw the ivory quickly, and where the gum has touched marks will be shown that must be cut away with a half-round graver. The ivory must be again inserted in the mouth and the painted parts cut out repeatedly until the pressed side shows a full painted surface. Teeth are then marked with a pencil on the round of the shape, and worked out with a small diamond-shaped graver. On the flat surface side of the shape mark out the cutting edges of the front teeth and the area of the grinding surfaces of the back teeth, then within those marks hollow out the whole shape, with the exception of those parts occupied by the marked-out teeth, to the thickness of $\frac{1}{16}$ in. Finish off carefully with a scraper and very fine sandpaper, polish with washleather and superfine pumice powder, then gloss with cotton-wool buff and whiting.

Slag Bricks.—In 1876 Mr. Charles Wood, of the Tees Iron Works, Middlesbrough, patented a process of making bricks from blast-furnace slag by casting them in sand moulds stacked one over the other in tiers on a waggon. The heat of the mass was sufficient to anneal the bricks if sufficient time were allowed for cooling. This annealing by slow cooling is the most important part of any process for making such castings. In the same year a similar process was patented by Bolton and others, but in this case the moulds were first heated by being surrounded with molten slag. Since that date many other processes have been invented. One process consists in running the slag direct from the furnace into the moulds, which are fixed on a movable turntable. The moulds pass under the slag spout and the table stops until each mould is filled, and then brings the next mould under the spout. A crust soon forms over the molten slag, and the moulds, which are of iron, with hinged lids, are opened so as to allow the blocks to fall out. The blocks are then taken to the annealing oven.

Extension Ladder.—Here is described how to construct a strong and easily made ladder, 15 ft. long, to be in two parts, one part being 9 ft. long over all. When opened to full length the base of the ladder will be quite 6 ft. from the wall against which it will rest. Owing to the ladder having to stand out so far at the bottom, it will be necessary to make the sides of rather strong stuff. The best wood to use will be 3-in. by 2-in. sound red deal, straight grained and free from knots and shakes, finished to about 2¼ in. by 1¼ in.; the sharp arrises should be planed off. The rungs should be of 1¼-in. by 1-in. material, and should be about 9 in. apart measuring from centre to centre, being fitted into notches cut in the sides, and fixed with a couple of 2½-in. nails or screws (the latter preferred); see Figs. 1 and 2. To allow the upper ladder to slip behind the lower, the two bottom rungs can be let into the sides their full thickness as shown at A (Figs. 2 and 3). The breadth of the lower ladder at the bottom should be about 18 in., gradually tapering so that when both parts are joined the breadth at the top will be about 12 in. The irons, about 1½ in. by ⅛ in., and fixed on with screws, must be secured to the sides before the two top rungs of the lower portion, and before the two lower of the top portion. Provision should be made to keep the ladder from slipping.

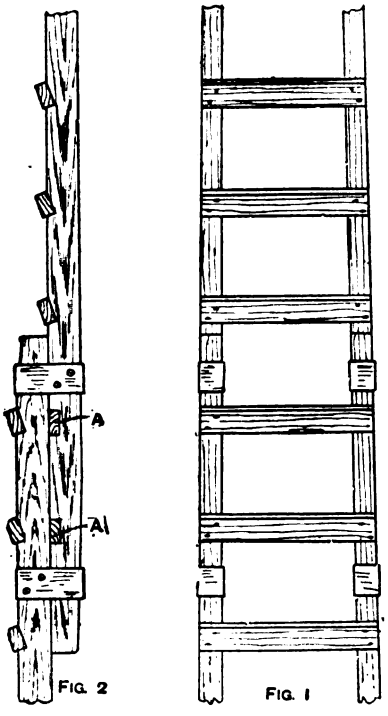


FIG. 2

FIG. 1

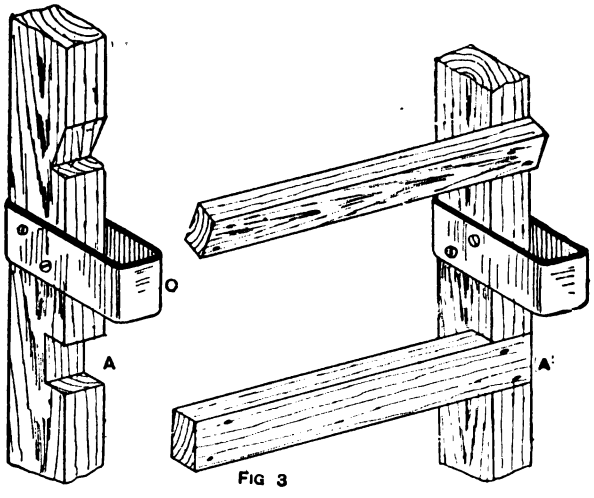


FIG 3

An Easily Made Extension Ladder.

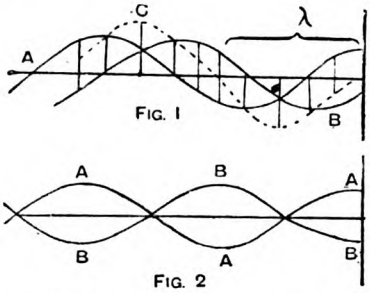
Calcium Carbide for Acetylene Gas.—Calcium carbide in contact with water generates acetylene gas, and in his standard work on acetylene Prof. Lewes says that the appearance of calcium carbide varies greatly; sometimes it is in a fine crystalline condition, having its surface shot with iridescent colours, whilst other samples present a steel-coloured fracture consisting of very minute crystalline faces. This difference once was thought to indicate degrees of purity, but now it is generally recognised that ingot carbide, which has been cooled very slowly, forms large fine crystals, and these owe their wonderful colours to films of oxide on their surface; the steel-coloured variety generally is run carbide, the rapid cooling of which has allowed the formation of very minute crystals only. A very dark graphitic-looking carbide with streaks of blacker shade is often bad, having been over-heated in the furnace. The size of the carbide lumps differs with the style of generator with which the carbide is to be used. For large generators, pieces the size of an egg and up to the size of the fist are convenient, whilst for some automatic generators and for bicycle lamps granulated carbide is wanted. At some works standard sizes are adopted, a convenient classification being lumps, 2 in. to 4 in.; large nuts, 1 in. to 2 in.; small nuts, ½ in. to 1 in.; granulated, ¼ in. to ½ in.; and siftings, which are more or less fine powder.

Cleaning Beer Barrels.—Beer casks generally are cleaned by being steamed out. They are first well washed with water, then a flexible metal tube attached to a boiler is placed in the bung-hole and steam is blown through; this treatment kills any fungus spores, and therefore prevents mould growing. Another treatment is to well rinse with a solution of sulphurous acid or bisulphite of lime every part of the interior of the barrel, and then to wash it out.

Dark Colour on Walnut.—In obtaining the dark tone seen on much American walnut furniture, if the goods are finished by French polishing the wood may be darkened by walnut stain made by mixing vandyke brown in liquid ammonia and thinning out with water. Another plan is to chrome the goods—that is, wipe them over with bichromate stain (1 oz. of bichromate of potash to 1 pt. of water), or a quantity of chrome stain may be added to any ordinary walnut stain. The filling-in is also heavily tinted. Many polishers, however, prefer to paint the goods. Then, after the preliminary stages of filling-in and bodying up, suitable colours, as umber, vandyke, black, and red, are mixed in 1 part varnish, 3 parts spirit. The mixture is applied with a camel-hair brush, the lighter portions being more frequently coated till a uniform colour is obtained: this is then smoothed down and a coat of spirit varnish applied. An American system, known as oil finish, consists in using heavily tinted grain fillers and coloured varnish, the cheaper grade goods being glass-papered and the best grade goods pumiced smooth. Afterwards, to complete the work, it is coated with japan varnish thinned with benzine; this imparts a dead glossy finish, which is pleasing in appearance but which readily blooms, presenting a surface to which dust clings, till such time as constant cleansing and friction impart a bright surface.

Purifying Acetylene.—The first process for purifying acetylene is to pass it through water to remove all condensible products. To do this, solder gas-tight at all parts a tin having a 1-qt. capacity, and make three holes in the top. In one hole insert the gaspipe from the generator and let this pipe dip down 4 in. From another hole take a pipe for the cleaned gas. This pipe does not dip inside the tin. The third hole is fitted with a stopper. When using the appliance, remove the stopper, fill the tin with cold water to within 1 in. of the top, then replace the stopper. If further purification is required, the gas may be passed through bleaching powder mixed with coke or brick powder, and afterwards through lime. This can be done by making a tin cylinder with tightly fitting lid and having perforated trays. The materials can be placed in muslin on the trays; the gas should rise through these. Purchase the purifying materials ready prepared.

Photography in Natural Colours.—All three-colour processes of photography are complicated and cannot be successfully worked without a specially constructed camera. Briefly, the three-colour process consists of taking three separate negatives of the same subject through suitable colour filters. Blocks are made from each of these negatives—or each negative may be lightly printed in carbon—and the three impressions thus obtained superimposed upon one base. The three primary colours thus combining in different proportions give the variety of tints and intensity necessary. The results are not, however, accurate, as mixing pigments does not produce the same effect as mixing light. The most useful work for an experimenter to take up is the Lippman process. In this process the colours are formed by interference, and the results are the nearest approach to natural colours yet produced. An ordinary camera may be used, but a special dark slide is required, the slide being fitted with springs to hold the film lightly against a rim of rubber so that a wall of mercury may be formed against the sensitive film by running this between it and the back of the slide. The plates used must be absolutely free from grain and transparent, so that the light may pass freely through the film and be reflected back upon itself. When this occurs at certain points the two influences will interfere, causing more or less action, as the case may be, and forming a laminated deposit of silver, and when this is developed and viewed under precisely the same conditions as those used to take the photograph (that is against a mercury plate), the rays returning to the eye will be diffracted and the original colours appear.



Diagrams Illustrating Photography in Natural Colours.

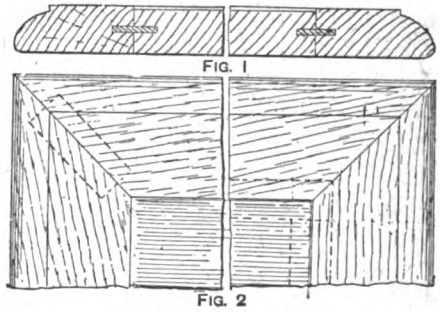
To understand how such an effect is produced, the theory that light is a wave motion of ether—that infinitely elastic fluid pervading all space—must be accepted. Now when one of these undulations—represented by the line A (Fig. 1)—meets a reflecting surface, it is sent back as by the line B; that is to say, if it meets the reflecting surface as a crest it returns as a trough, or *vice versâ*, the sum of the two influences being shown by the dotted line C. For it is easy to see that if there are two influences A and B (Fig. 2), one of which starts half a wave length later so that one influence is rising where the other falls and falling where the other rises, the total effect will be nil, for one counterbalances the other (this is readily proved by experimenting with diffraction grating, Grimaldi's mirror, etc.). Then at the points where the wave is highest or lowest, there will be most action, and consequently most silver reduced, whilst at points where the swing is least there will be no action whatever; for the dotted line does not represent an actual wave surface, but only the proportionate swing of a particle, or the relative disturbances in the film. Ordinary pyro and ammonia developer may be used. The plates are, of course, extremely slow, and a long exposure is required—often twenty minutes in sunlight.

Copying Old Photographs.—To make a negative from any picture it is merely necessary to pin the picture on a board, fixing it square and parallel with the camera; the camera is considerably extended, according to the size of the image required and the focal length of the lens. Much depends on the condition of the original photograph, but good results can be secured even from the most faded photographs by correct exposure and development and the use of suitable plates and apparatus. A certain amount of skilful retouching is usually required on the negative and on the print, and for this reason the platinotype process should be employed. As a rule, the field cameras used by amateurs do not allow of sufficient extension to make a negative of the same size as the original, because to do this the camera must open out to at least twice the focus of the lens. This difficulty may be overcome, however, by means of a conical or box extension fitting into the camera front or by combining two cameras. A small stop and slow plates should be used, and when the original is weak in contrast a hydroquinone developer is suitable. (See also Series I., p. 141.)

Theory of Acetylene Production.—The reactions taking place when calcium carbide is brought into contact with water are made clear by the following simple equations, which, in a slightly different form, are given in Prof. Lewes' standard work "Acetylene."

64 parts by weight. 18 parts. 56 parts.
(1) Calcium carbide (CaC_2) + water (H_2O) = lime (CaO)
26 parts.
+ acetylene (C_2H_2).
56 parts by weight. 18 parts. 74 parts.
(2) Lime (CaO) + water (H_2O) = calcium hydrate or slaked lime ($Ca(HO)_2$).

Writing-table Top.—Writing-table tops having leather centres usually are constructed as in Figs. 1 and 2, which show a section and plan respectively, the moulded rim being mitred round the centre and fixed with a ploughed and tongued joint. The rim stands $\frac{1}{16}$in. bare above the centre, so that when the leather is laid it will lie flush. The centre, which is generally of pine, is prepared true on the surface, squared up to size, and ploughed from the back; the hardwood rim is moulded and ploughed also from the back, the side pieces being jointed and mitred, then cramped on and the end pieces fitted. The pieces are



Writing-table Top.

then glued on in the same order, the cramps for the ends going under the top, and for the sides above. The rim is cleaned off flush with a small piece of the leather to be used in covering. The leather is fixed with bookbinders' paste, a little glue being sometimes used around the edges, but great care must be exercised or the glue will come through and spoil the surface. The best covering is tanned sheepskin (levant is the trade term), but for common work use good American oilcloth, which has a linen back and will fold without cracking.

Metallic Silver and Silver Nitrate.—In turning nitrate of silver crystals into metallic silver, 108 parts by weight of the silver are displaced by 32·5 parts by weight of zinc. Accurately weigh the nitrate of silver and work out the proportion of zinc required; clean zinc foil should be used. Dissolve the silver nitrate in just sufficient distilled water in a beaker and add the zinc. Ascertain if all the zinc is dissolved by gently stirring the solution with a glass rod. When all the zinc has dissolved, decant and wash the precipitate by decantation. Transfer the precipitate to a clean crucible, carefully scraping out the beaker with a scapula, and swilling out with a little distilled water so that nothing is left behind. Slightly move the lid of the crucible to allow the air to escape, and thoroughly dry the precipitate in a hot oven.

Setting Drum Lever Clock in Beat.—To test whether a drum lever clock is in beat, stop the balance with the finger and see that it has no greater tendency to rest on one pallet than on the other. When the clock is in beat with the balance at rest, the impulse pin on the balance arbor should be in the lever fork, the lever and impulse pin being in a straight line. If not, the lever is bent. To test further, draw the balance half-way round to one side and try the shake of the lever fork against the balance axis. There should be perfect freedom and some shake. Draw the balance round the other way, bringing the lever on the other side and test again. The shake on both sides should be equal. If the lever seems tight on either side, bend it free.

Waterproof Cement.—The Chinese waterproof cement schio-lino appears to be made by beating fresh blood, and mixing it with about its own weight of slaked lime and a little alum. The cement is strong; two or three coats will render articles waterproof. There are several cements of this class, *i.e.* blood and lime, white of egg and lime, and casein and lime. These cements harden very quickly, and therefore they cannot be kept in a fluid condition; they must be made when they are required.

Set of Lockers.—Figs. 1 and 2 show respectively an elevation and horizontal section of a set of twenty lockers, each division having a door and being 7 in. wide, 8 in. high, and 10 in. deep. The sides, top, bottom, and divisions should be of 1-in. stuff planed down to about ⅞ in. The sides, bottom, and top should be dovetailed together. The form of these joints is shown at A (Fig. 3). The sides should be grooved to receive the ends of the shelves and the shelves grooved for divisions, as shown by Fig. 3. It should be noticed that the grooves do not extend to the front edges. Use ¼-in. matchboarding in narrow widths for the back. This should fit into a rebate formed in the bottom, top,

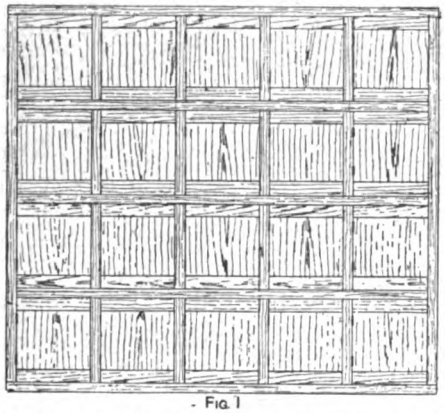


Fig. 1

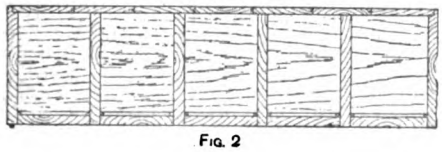


Fig. 2

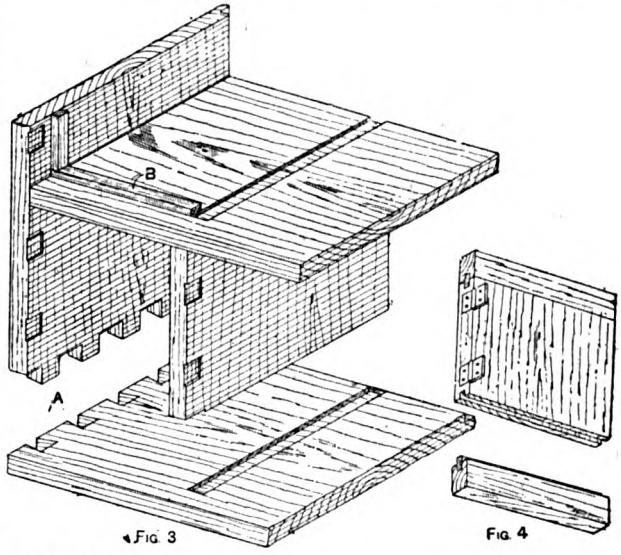


Fig. 3 Fig. 4

Set of Lockers.

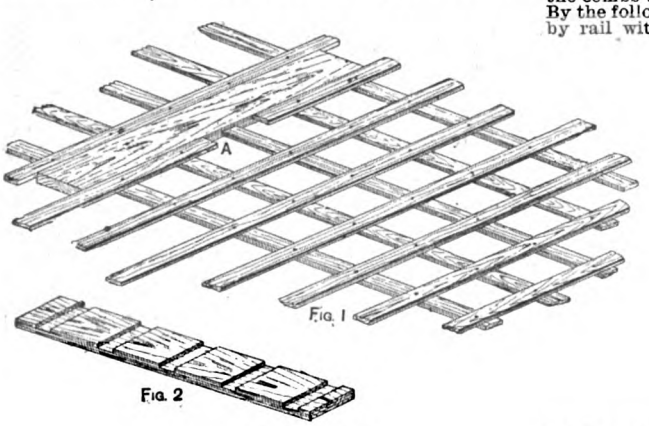
and sides (see Fig. 2). The doors may be of 1-in. stuff, the grain running vertically, the top and bottom being clamped. The simplest method of doing this is to plough the end grain of the doors and also the clamp, then insert a tongue, and glue together. This construction is shown at Fig. 4. For hanging the doors to the divisions use 1½-in. broad butt hinges. Nail on a ⅜-in. by ½-in. stop against which the doors shut, and, if it is desired to keep out the dust, the stop may be continued all round, fitting against the doors when closed. These stops are shown in Fig. 2, and also at B (Fig. 3). If the doors are to be fastened, turnbuckles, cupboard locks, or padlocks may be used. The appearance will, of course, be much improved by fixing a piece of cornice moulding round the top.

Fitting Spur-box in Heel of Boot.—A spur-box is built into the heel of a boot in the following way. After deciding the distance at which the box is to be placed from the seat, proceed to build up the heel to this height, to within the top lift. This, perhaps, would need the sole, splitlift, and lift; the two latter, and also the next two lifts, should be of good solid leather. When these are secured, round the heel up as required, the spur-box being the guide. The spur-box is of brass and iron, and is long and narrow, with a steel spring to keep the door closed and also to keep all grit from the interior. The door in its turn presses in a grooved portion of the shank of the spur, and keeps it fast while in place on the boot. The front, or door portion, of the box is the only part that should show in the heel. The front slants slightly towards the top-piece; while on the bottom, in about the centre, are two small projections with holes in their centres. Another lift can now be temporarily tacked on, rounded up, and then removed; put this lift on the lap-iron, place the box on it in the proper place, leaving a little leather beyond the door to be worked and pared when the heel is built, and gently hammer the box on the lift so as to leave an impression. This portion of the lift must be cut away, but not quite through, so that the bottom of the box, with the two projections, fits without shake. A lift is now cut to the same size as the one just made. The part cut from the first lift should be from the grain side, and the edges can be chalked and the other lift tapped in like manner to the box. This gives an outline on the flesh side, and the piece so marked can be cut away, but in strip form only—that is, so that it only makes room for the box and not for the two side projections. The whole can now be temporarily placed on the heel and another lift tapped on, a portion of it being cut away to make room for the box. The whole is then again taken off, the first lift well nailed on, the box fitted in, the second lift put on, and a rivet put in each side, so as to go through a hole in each side of the box. The lift is now well pegged round the box, and the cover lift riveted on to keep all secure. Everything should be done to make the heel as solid as possible, such as good sewing, sticking each lift with gelatine, etc., and when putting in any rivets over the box, care must be taken not to have them long enough to reach the box, or when clinching they may draw away the lift, which could not be replaced. Also, the lifts must not be used too damp. Some workmen fit the lifts as above described, and sew the whole (excepting the cover lift) down together, so arranging the stitches on the lift side that they do not interfere with the place made for the box; but a novice would find this method somewhat difficult.

Spirit Varnish.—Spirit varnish, if left exposed to the air for several days, evaporates and thickens in warm dry weather. In damp weather it absorbs moisture, sometimes to such an extent that when laid on it turns white or milky, and does not lie level, but gives a ropy appearance; in that case it can often be rectified by being placed in a warm position, shellac being added, and thinning out with wood naphtha. The better plan is to strain the varnish into a wide-mouth glass jar; the cork of this should be tightly fitted with a penholder, on which the varnish brush may be tied, the brush, when not in use, being suspended inside the bottle. If the varnish brush has a handle of wood this portion may be fitted into the cork instead. If the brush is of a kind having the hairs bound in tin, it should hang inside the jar so that only the hairs touch the liquid; the tin portion should not remain in the varnish longer than is necessary for use. Neglect of this precaution sets up a corrosive action that causes the varnish to smell disagreeable. If the brush has become hard through long exposure, it may be softened fit for use again by immersion in methylated spirit, made lukewarm in an oven; the warm spirit penetrates better

Material for Making Toy Balloon.—Calico may be used for making toy balloons if these are not too small. Calico is, however, slightly porous, and would need a coat of elastic varnish to make it absolutely gastight. A suitable varnish may be made with 1 oz. of india-rubber and 1 qt. of drying oil dissolved in a closed tin or jar by surrounding the latter with hot water. This varnish will dry in about forty-eight hours after being laid on. If too thick, it can be thinned with oil. A better and quicker drying varnish may be made by dissolving cold, in a closed vessel, 1½ oz. of indiarubber, cut up in small pieces, in 1 pt. of chloroform, ether, or bisulphuret of carbon. This dries immediately. A better material than calico is the thinnest unprepared Scotch cambric or tussore (or some other cheap silk) covered with several coats of varnish; an examination with a strong magnifying glass will readily show when the interstices between the threads have been filled.

Trellis Work.—In making a trellis, assuming the laths are all of one breadth, prepare a piece of ⅝-in. or ¾-in. board of the same width as the desired distance between the laths, and on one side of the board make grooves to hold five or six laths, the grooves being at the same distance apart as the width of the board (see Fig. 2). Now fit a few laths into the grooves in the board, which should be laid over the laths near one end. Then a lath can be placed on and



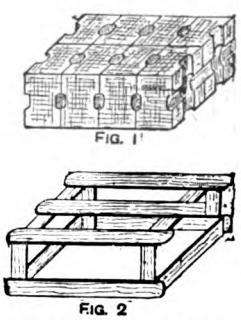
Trellis Work.

nailed through into the lower laths, first fixing one on each side of the board. The board may then be moved to the other end of the second lath, and the third lath can be nailed in position. Move the board lengthwise of the under set as laths are added. This process can be repeated until the work is finished. As will be seen, the object of using the board is to keep the lower laths in position whilst the upper laths are being nailed on (see Fig. 1). The laths should be fixed together with copper nails or small French nails, a piece of iron being placed beneath the lower laths so as to clench the nails when driven through by turning them backwards. If only one nail is used for each joint of the trellis, by merely moving the laths the spaces between them may be either square or diamond shaped. It will be noticed at A (Fig. 1) that a lath is broken away so as to show the board clipping over the under lath.

Ageing an Oak Cabinet.—To remove the appearance of newness of oak furniture, after seeing that it is perfectly clean, and free from glue, varnish, polish, or other marks, sponge it over with strong coffee; rub this well in, and wipe off with a clean rag that has just been wrung out in hot water. A slightly darker tone can be obtained by brushing or sponging the furniture with a solution consisting of one pennyworth of carbonate of soda dissolved in 1 pt. of boiling water. A still darker tone can be gained by using common washing soda instead of carbonate of soda. Wiping over with water strongly impregnated with lime will also give a nice tint. Experiment on odd pieces of wood before starting on the cabinet. The secret of success lies in a clean surface and in using the solution weak rather than strong, gaining the desired result by two or three applications instead of one; and by sponging off with hot water the stained or "doctored up" appearance is avoided.

Wax for taking Impressions.—A wax that can be used for taking impressions by hand pressure of mouldings or carvings is made by melting 2 lb. of clear beeswax in 4½ oz. of venetian turpentine, adding 2 oz. of lard and 2½ lb. of precipitated bole, and mixing and kneading well together. To prevent bubbles, the beeswax should be melted at as low a temperature as possible. But modelling wax, which can be bought of dealers in artists' materials, will prove much more satisfactory than a home-made article. Artists' modelling wax is fairly rigid, and may be softened by working or by immersion in water. To prevent the wax sticking, the object from which an impression is to be taken should be brushed over with a little paraffin in which a piece of stearine or wax candle has been melted. Should the ornament be undercut, the wax may be pressed into the undercut parts, the edges being carefully trimmed up and coated with paraffin and stearine so as to prevent the wax, when applied to the exposed portions, from sticking to these loose pieces. When using loose pieces, it is advisable to allow them to cool, or become stiff, before applying the wax to the other parts of the ornament. For simple ornament in low relief, an impression may easily be made by using ordinary modelling clay.

Packing Honey Sections.—Fresh sections of honey if packed simply in a wooden box are extremely liable to damage when sent by rail, for when the box drops on the platform, however tightly the sections may be packed, the fall is almost certain to break some of the combs away from their attachments to the sections. By the following plan honey may be sent a long distance by rail without injury. The roughest wooden boxes



Packing Honey Sections.

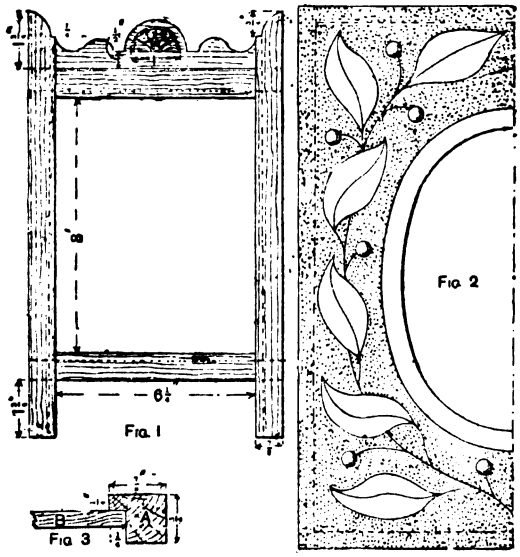
can be used, so that it is not necessary to have them returned. Procure a box 2 in. or 3 in. larger every way than the space occupied by the sections. If, for example, eight sections are to be sent, place these on a table right side up as they were in the hive (see Fig. 1). Then make a crate in which the sections fit exactly, as Fig. 2. This may easily be done with a saw, hammer and nails, and bradawl, from a grocer's box. Leave the ends of the top and one side unfastened until the sections are in, then finish nailing. Place about 2 in. of some elastic substance like shavings in the bottom of the box, and over this one or two folds of paper; upon this place the crate of sections. Pack all round the sides and the top in the same manner, fairly tight, but so as to leave a certain amount of elasticity. For heavier weights there may be used spiral springs about 2 in. long, made of wire, just strong enough to give a little with the weight. Two underneath, two on top, and one at each of the four sides might be sufficient. They can be fixed with nails, and could be returned by post.

Ridding a House of Blackbeetles.—To rid a house of blackbeetles (1) place fresh cucumber peel on the floor at night; in the morning the beetles will be found dead. Repeat the dose two or three successive nights until the beetles are exterminated. (2) Make a powder of equal parts of flour, sugar, and red lead, and place this where the beetles can get at it. (3) Dissolve about 2 lb. of quicklime in a pail of water and well stir. Pour this down the crevices from which the beetles come.

Repairing Corrugated Iron.—The best way of repairing sheets of corrugated iron in which there are several large holes will be to cover the holes with sound pieces of the same material. The pieces should be fitted to the holes, and then soldered in position. The iron must be well cleaned by scraping, or by other suitable means, where the soldering is to be done, and raw spirit (hydrochloric acid) used as a flux; the iron can then be soldered with ordinary tinman's solder and a copper bit in the usual way.

Transfers for Cycles.—Transfers for cycles are printed on a litho machine in the same manner as bottle labels or any other lithographic design. A separate stone is used for each colour, and the gold is put on with bronze powder. There may be as many as fifteen or sixteen separate printings to make up the complete design. If a large quantity of transfers is desired, it is usual to print on large sheets and cut them up afterwards. The transfers are printed on thin paper, which is afterwards coated with a mucilage of some kind. When dry, a cover paper is gummed over to protect the transfer when it is being applied to the cycle. The transfers are cut up with a shaped punch close to the design. When applying the transfers to the cycles, the thin paper is damped and placed in position and rubbed gently but firmly to ensure the transfer adhering. After this is dry the cover paper is damped, and if properly done it will slip or peel off, leaving the transfer in position.

Screen Photograph Frame.—Fig. 1 shows one fold of a screen photograph frame; two of these hinged together form a very pretty article. The four joints may be either mortise and tenon or half lap, and the inside edges of the frame might be stop-chamfered. The piece of ornament on the top will be 6¼ in. long so as to fit in the rebate, and therefore stands back ¼ in. The mount may be plain cardboard, or wood covered



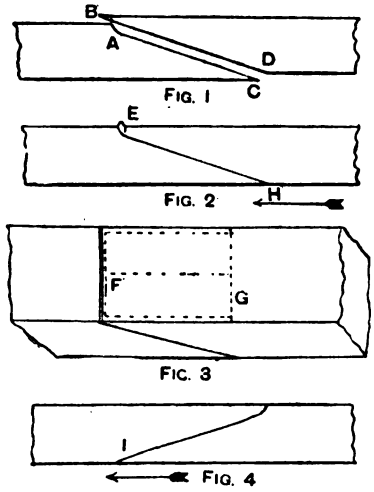
Screen Photograph Frame.

with plush, or a carved wooden one as in Fig. 2; this is of ⅛-in. mahogany, and the carving is incised. The pattern is gone round with a V tool or small veiner, and the leaves are slightly modelled, the edge of the opening of the mount being bevelled; or it may be fluted at right angles to the curve with a small gouge. The ground may be stamped. Fig. 3 shows a section of the moulding A, with the mount B.

Quick-setting Putty for Glass.—For fixing glass in cabinet work and for some other purposes, ordinary putty is undesirable and a special quick-setting putty is used; this may be made as is described below. Place in a jar 2 oz. of glue, cover it with water, and when soft melt it down in a pan of boiling water. Now add sufficient water to the glue to form a thin size. While this is warm, mix it to a thin paste with plaster-of-Paris. As this cement sets almost immediately, only a small quantity should be made at a time. The plaster may be coloured with the usual pigments, or a colour-wash can be applied after it has set.

Black Line Photo Copies.—Poitevin's process is one means of getting black lines instead of blue when printing from tracings; but there are many processes for obtaining black line copies by developing the image with chemical solutions. Poitevin's process is as follows. Dissolve 1 oz. of gelatine in 15 oz. of water, add 100 gr. of Indian ink, and mix very thoroughly. Float the paper on this mixture while warm for three minutes, then dry quickly. Immerse the paper until limp in a bath composed of tartaric acid, 7 parts; iron perchloride, 24 parts; and water, 240 parts. Dry the paper again quickly, this time in the dark. Print in the usual manner under a tracing, and develop by washing in warm water. The process depends on the fact that ferric chloride renders gelatine insoluble, and that light converts ferric chloride into ferrous chloride, which does not influence the gelatine. Hence, when the paper is exposed under a tracing the light acts on the parts which are not protected by black lines and renders the gelatine soluble in warm water. In the parts protected by the lines of the tracing, the gelatine still remains insoluble and sticks to the paper, and as it was made black by the addition of the Indian ink, a black reproduction is obtained.

Splicing Machine Belts.—The following gives a few hints on the splicing of machine belts. Supposing the belt is new, or the break a fresh one, take the bottom piece as Fig. 1, and skive it through in a direct slant; then take out a shallow groove right across as at A. The top piece can be skived in the ordinary way, but left a little longer at B so that the thin end may be cut off; or both pieces can be fitted like the bottom one, but in this case there will be an abrupt end at C, and D will need a groove. If it is desired to stick the splice prior to stitching, ordinary patching solution should be used. This is made by cutting pure guttapercha into shavings, covering with bisulphide of carbon, and applying heat; this must be done very care-



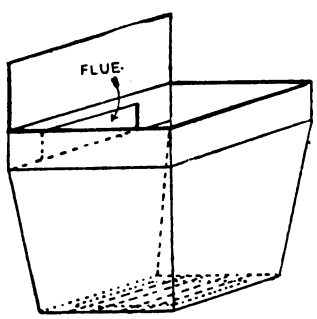
Splicing Machine Belts.

fully and slowly, or combustion will take place. It is only necessary to stick the end edges A B and C D for about ¼ in.; this is better than sticking them all over, as the splice is rendered more pliable. On looking at E (Fig. 2) it will be seen that if the splice is stitched through as shown a sharp corner will be left—this is done to produce abrupt ends, which can soon be trimmed off and smoothed up, thus making a more solid seam than if there were a very thin edge to turn up. One great point in making a splice is the stitching. The thread should not be too stout, and the awl not too thick; the awl should be about the substance of the thread itself; plenty of wax should be used on the thread. Fig. 3 shows the best way to stitch a splice. If possible have only three plain rows of stitches; the two cross rows F and G can be put in if desired, but the stitches should be long, as the making of too many holes tends to weaken the belt. Finally, it will be advisable to explain how to make the splice go over the pulleys. Assuming the three joints as shown were going from left to right, the point at H in Fig. 2, against the arrow, would each time in passing over come in contact with the wheel and jerk the first few stitches, and every revolution would make matters worse. To obviate this, reverse the splice as shown in Fig. 4; the pulley will then pass over the seam at I as shown by the arrow.

Preventing Violin Pegs Slipping.—If the violin pegs are of ebony or blackwood, rub them with blacklead; if of boxwood or light-coloured wood, rub with chalk. Sometimes a peg slips because the hole in it is not nearly in line with the groove in which the string lies at the end of the finger-board. A remedy is to bore a fresh hole in the peg.

Renovating Wooden Violin Case.—To remove the varnish from a wooden violin case and leave the surface clean to receive another stain is a tedious job. The fittings should first be removed, and the varnish taken off with a cabinetmaker's steel scraper or a piece of glass; then smooth up with several grades of glasspaper. At least four coats of a combined stain and varnish of a walnut or mahogany colour may be applied with a camel-hair brush. Allow each coat to get dry before applying the next, and if necessary smooth the surface each time with finest grade or worn glasspaper. Clean and polish up the fittings before replacing them.

Melting Small Quantities of Brass.—The only way in which small quantities of brass may be melted by gas is by using an injector furnace. The gas is mixed very intimately with air by means of a small footblower, and is conveyed to the inside of the furnace, where on ignition sufficient heat is generated to melt brass in ten or twelve minutes, starting cold. In the absence of a furnace, gas or other kind, the following expedient might possibly be adopted with a good kitchen grate. A hollow casting, about ¾ in. to ¼ in. thick, similar to the sketch, must be procured, the measurements being taken according to the measurements of the grate. If only 2 lb. or so of metal are to be melted at a time, the casting might be used as made, but it would be preferable to line the inside with ½-in. or 1-in. firebrick slips to protect the iron. The casting should be put in the well of the grate, and the opening to the chimney above the casting should be stopped with a plate of sheet iron to prevent air passing up other than through the furnace. For fuel use gas coke, and when the fire is started, cover the top of the casting with a plate of

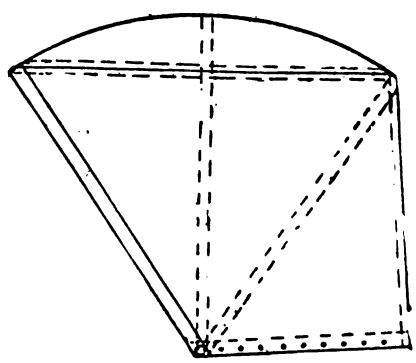


Hollow Casting for Melting Brass.

iron or a firebrick slab, when the air drawn up by means of the chimney draught will pass through the furnace and create a heat suitable for melting brass. A crucible allowing 2 in. spacing all round may be used, so that a very fair quantity of metal may be melted at a time. Of course, a wooden pattern from which to cast the iron will have to be made; it must have a slight taper from top to bottom, so that it can be withdrawn from the moulding sand. Allow a 1-in. flange on the bottom to carry three or four 1-in. square wrought-iron firebars.

Hawker's Float.—A hawker's float of an average size to be drawn by a pony would be 5 ft. long by 3 ft. 6 in. wide, outside on the bottom, having a sail out each side of 1½ in. in the depth of 1 ft. 6 in., and a throw-out at the tail end of about 10 in. The bottom framing is made up of two bottom-sides 2½ in. wide by 1¾ in. thick; two summers, 1¾ in. square; one hind ear bed, 2½ in. deep by 1¾ in. wide; one front capping bar, 2 in. wide by 1¾ in. deep; the whole being dressed and framed together. The standards, five each side, are 1½ in. square and are framed into the bottom-side and top rails with bare-face tenons ¼ in. (full) thick, so that the outer faces of all the parts come level. The top rails are 1¾ in. deep by 1½ in. wide, and, when framed on to the standards, should measure in depth 1 ft. 6 in. at the tail end, tapering down to 1 ft. 2 in. at the front part, from the top of the top rail to the bottom of the bottom-side. The floating or outside raves are of the same size as the top rails, and are fixed to the body by light iron stays, being kept about 4 in. outside, and rising, say, 2½ in. above the top line of the body. The panels are of ½-in. birch, fixed to the standards by screws, the bottom boards, of ¾-in. red deal, being put in crossways of the framing. The shafts are fixed along the inside of the bottom-side, being 2 in. thick by 2½ in. wide at the largest part, and having a length of 5 ft. 6 in. in front of the body; they are strengthened by inside braces, which are fixed to the summers on the body. The front steps are about 1 ft. 3 in. deep, the top part of the crown being left long enough to take the shaft brace; iron handles are fitted at both ends of the raves to give it a finish, and two stout stays carry the cross-rails at the tail end. The springs are 4 ft. 2 in. long to the centres of the eyes, the compass from these centres to over the last of the six plates being 6½ in., and the width of the steel 1¼ in. The scroll irons are of the ordinary swan-neck pattern, 2½ in. deep at the front part and 4 in. deep at the hind part. The axle may be a common grease one, or a Collinge, 1¼ in. in diameter, with a solid flap for 1¼-in. springs, the distance between the flap and the collar being 2 in., and the length of boxes 8½ in. The wheels are 4 ft. 2 in. high when tyred, with 1¼ in. spokes, and felloes 2 in. wide by 1¼ in. deep; the stocks are 7½ in. in diameter by 8 in. long. The framing, shafts, and braces should be of the best English ash, thoroughly dry and tough.

Re-covering Mailcart Hood.—The hood of a mail-cart may be re-covered in the following way. With a hammer and an old screwdriver strip off the existing cover by knocking out the tacks; if possible, do this without damaging the cover, which will form a pattern for the new cover. Hood covers are usually made up of four parts, viz. back piece, top piece, and two sides. The linings are made from serge, coloured sateen, or other soft goods. The lining is put on first, and the four pieces are machined with the seams to the outside. Tack the lining to the bottom rim first, then bring it up under the hood-sticks; bend the back hood-stick until the head is linable with the back rim, and sew the lining fast. The centre hood-stick is fastened between the front and

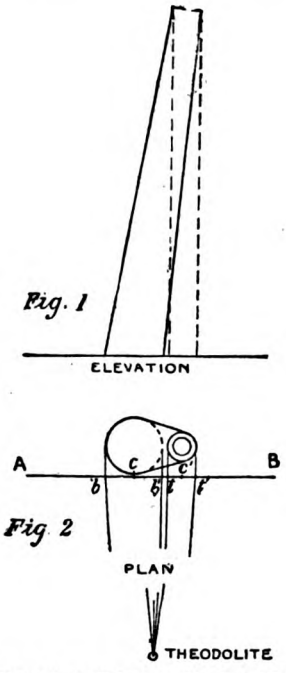


Re-covering Mailcart Hood.

back hood-stick; the front edges of the lining are tacked fast on the front edge of the wood hood-stick. The outside cover is first tacked in the centre of the back rim and brought over the hoops, the brass joints are slightly loosened, and the cover is tacked fast in the centre of the front hoop. See that the grain of the material is straight, and work to the bottom edges; the tack heads are hidden by narrow coloured gimp fastened with gimp pins. If the cover does not set properly, the positions of the brass joints must be altered; lowering them at the hoop side will give more stretch; highering them will give less stretch. If warmed before being put on the leather cloth will lie better and will not peel and crack. The illustration shows the positions of the hoop-sticks and seams when the hood is fully opened.

Photographic Impressions on Copper Plate.—The carbon process of obtaining photographic impressions on copper plate for engraving, etc., consists in placing a paper (coated with a mixture of gelatine and some pigment and then immersed in a solution of bichromate of potash) in contact with a negative of the subject or design that it is desired to reproduce, and exposing in a printing frame to light. The bichromate on the portions of the paper affected by light becomes insoluble, but where the light has not acted the bichromate can be washed away in hot water. As the unaffected parts are in contact with the paper support, it is necessary to transfer the tissue, as it is technically called, so that the unaffected parts may be reached without destruction of the image. The tissue is moistened in cold water and brought in contact with the surface of the copper plate (which is coated with a layer of insoluble gelatine) under the water, and laid face up on a sheet of glass. Then with a flat squeegee the tissue is stroked into close contact and left to dry under pressure. The copper plate is then immersed in hot water, the paper support of the film stripped off, and when sufficient of the soluble portions have dissolved the plate is washed and put in alum to harden the film and remove the bichromate.

Plumbing Chimney Shaft with Theodolite.—There are various ways of using a theodolite when, by its means, it is endeavoured to ascertain how far a chimney stalk (circular or otherwise) deviates from the perpendicular. Find in which direction the chimney is upright by walking round it, say at a distance from the chimney equal to twice the height, then the direction of maximum inclination will be at right angles to this point. Set up a theodolite so as to get a view of the inclination (Fig. 1). Stretch a line on the ground at the base of the shaft (A B, Fig. 2), sight the top of the shaft and transfer the points $t\,t'$ down on to the line A B, then sight the bottom of the shaft and transfer the points $b\,b'$; now bisect $b\,b'$ and $t\,t'$ in points $c\,c'$, and the distance from c to c' will be the amount the chimney is out of plumb. Another method would be to set up a theodolite, keeping the primary circle fixed in any one position throughout. Clamp and unclamp the vernier, and turn the tangent screw for adjustment as required to read the angle of both sides of the top and both sides of the bottom. Then the difference between the mean readings at the top and

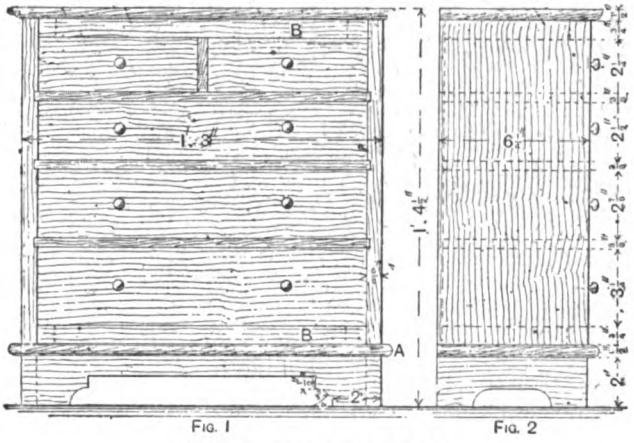


Plumbing Chimney Shaft with Theodolite.

the mean readings at the bottom will be the amount the shaft is out of plumb in angular measurement. To convert this to feet, find the value from a table of natural tangents corresponding to these degrees and minutes, and multiply by the distance from the theodolite to the centre of the shaft. Neither of these methods will be mathematically true, but they will be as near as the result will be wanted.

Tar Paving for Garden Paths.—For garden paths where there will be nothing heavier than foot traffic tar paving made with cinders and breeze may suffice. A good foundation is necessary, and clinkers, broken stone, or other hard ballast should be used, in a layer of, say, 4 in. to 6 in. thick, well rolled. To prepare the tar paving, the cinders should be made into a heap, gas tar, made hot in an iron cauldron, poured into the middle of the heap, and the whole turned over three or four times with spades until the heap is thoroughly saturated, and forms a sugary, sticky mass that seems to quiver with life. It is advisable to add to the tar about 5 per cent. of pitch. The mixture should be allowed to lie for a week or two if possible before it is put down on the path. The kerbs at the sides of the path having been fixed in their correct positions and at the proper level, the first coat of tarred cinders may be laid, 1½ in. thick. Gravel or broken stone of ½-in. gauge should be mixed with this coat. After laying, roll well, and then proceed to lay the finishing coat ½ in. thick, which may be of cinders and tar, or, preferably, may contain granite or limestone chippings of ¼-in. gauge. Let this be well rolled, and then give a coat of hot tar and sprinkle over it fine granite dust or marble chippings, and roll again as much as convenient; it is impossible to roll too much. If the path has to bear carriage traffic, tar paving such as is laid in town footpaths should be adopted. This paving may be made with a 4-in. foundation as before, a bottom coating, 3 in. thick, of gravel or chippings not larger than 2-in. gauge, another coat, 1 in. thick, of limestone chippings of ½-in. gauge, and a top layer, ¼ in. thick, of ¼-in. gauge limestone chippings, all mixed as described above with 12 gal. of tar, ¼ cwt. of pitch, and 2 gal. of creosote oil to each ton of stone. No cinders whatever are used in such a path. A porous stone like limestone answers much better than granite, which does not absorb the tar. In the best class of work all the stone and gravel is heated by roasting before applying the hot tar, but this heating is often dispensed with. (See also Series I., p. 77.)

Miniature Chest of Drawers.—A miniature chest of drawers might be made as a companion to the doll's bedstead described on p. 65. The feet are screwed on A, Fig. 1, which is the bottom of the carcase. If desired, the ends might be continued to the floor, the front ornament being fitted in, and a small bead planted on to form a projection as at A; or turned feet might be used instead of those shown. B and B are pieces of wood 1 in. by ¾ in.; similar pieces go across the ends and so form three sides of an oblong as shown by dotted lines in Fig. 2. Small turned knobs are screwed on as indicated.



Miniature Chest of Drawers.

Spirit used by French Polishers.—The purer the spirit used in French polishing, etc., the easier it is to work and the better will be the results. For all ordinary purposes there is no important distinction between methylated and unmethylated spirit, excepting the difference in price. The object of adding crude wood spirit, commonly called naphtha, is to impart a bitter taste to the mixture and so render it undrinkable. Methylated finish is generally adulterated with gum resins in order to satisfy the claims of the Excise authorities; the excessive quantity of resin added ofttimes yields a mixture very trying to the polisher, and prevents satisfactory clearing off. Wherever the pure spirit can be used, this annoyance is obviated.

Enamel Scaling off Cycles.—Rust under the enamel is the sole cause of an enamel coat scaling off a cycle, and its presence proves that the steel was not properly treated before being enamelled. An effectual cure can only be brought about by scraping the parts affected and by thoroughly cleaning the whole surface that it is required to enamel.

Tuning Ariston Organette.—Following are brief instructions on tuning an Ariston organette. To sharpen the reeds, file or scrape the free end; to flatten them, file or scrape the fixed end. A thin strip of metal or a thin business card should be inserted beneath the free end of the reed to support it whilst being scraped. The pitch of the instrument can be found by comparing it with a standard tuning fork, or by comparison with a keyed instrument which is in tune and of the correct pitch.

Removing Copying-ink Stains from Mackintosh.—In attempting to remove copying-ink stains from a light cloth mackintosh without altering its colour, try methylated spirit applied with a cotton-wool dabber. If that will not remove the stains, dilute hydrochloric acid (1 part acid, 10 parts water) may be tried; after the stains are obliterated, treat with ammonia to neutralise the acid. As there is a probability of the acid changing the colour of the mackintosh, it would be best to try the acid first on a portion of the cloth that is turned up inside at the bottom; neutralise with ammonia after the trial. In using the acid, wet as little of the mackintosh as possible.

Drawer for Milk Perambulator.—Fig. 1 is a front elevation and Fig. 2 a side view of a drawer for a three-wheel milk perambulator, to draw out from below the tap of the churn. Fig. 3 is a section, one-third full size, of the slide and bottom-side of the perambulator. In Fig. 1 the drawer is shown in position beneath the framing of the perambulator. The width and depth of the drawer are governed by the fixing of the springs underneath the bottom-sides, and also by the clear space between the bottom of the framing and the top of the axle. The front part A (Fig. 1) is of birch, 1 in. thick; the sides B (Fig. 2) and the back are also of birch, ¾ in. thick. The bottom board C (Figs. 1 and 2) is screwed butt on to the carcase, the grain running across the length; the sides are dovetailed into the front part, leaving a bare ½ in. fence on, as shown in Fig. 2, the back end being boxed in from the back. The runners D (Figs. 1 and 2) are 1 in. square, of ash or birch, screwed on flush with the top edge of the drawer the whole length of the side. In

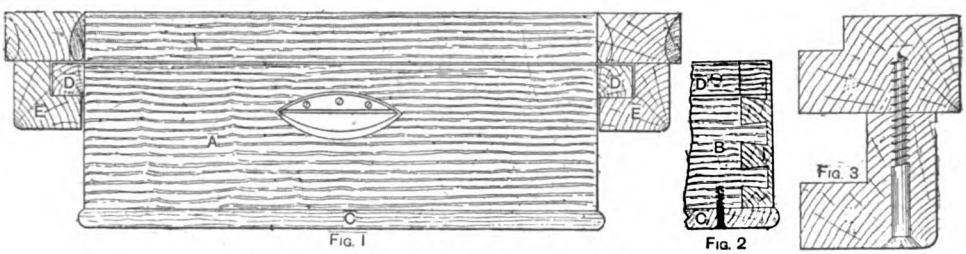


Fig. 1 Fig. 2 Fig. 3

Drawer for Milk Perambulator.

Fig. 2 the runner is purposely cut short to show the top dovetail. The slides E (Fig. 1) are of ash, 2½ in. square, boxed out of the solid as shown in Fig. 3, being fixed up from the bottom into the bottom side by screws. At the back end of the slides stops should be put on to prevent the drawer sliding too far under. A brass handle or loop is screwed to the front of the drawer to open and close it. If eggs are to be carried loose in the drawer, a small ledge or fillet should be placed round the inside, and thin boards, in which a number of holes about 1¼ in. diameter have been bored, fitted in; this would keep the eggs from rolling if they are placed end on in the holes.

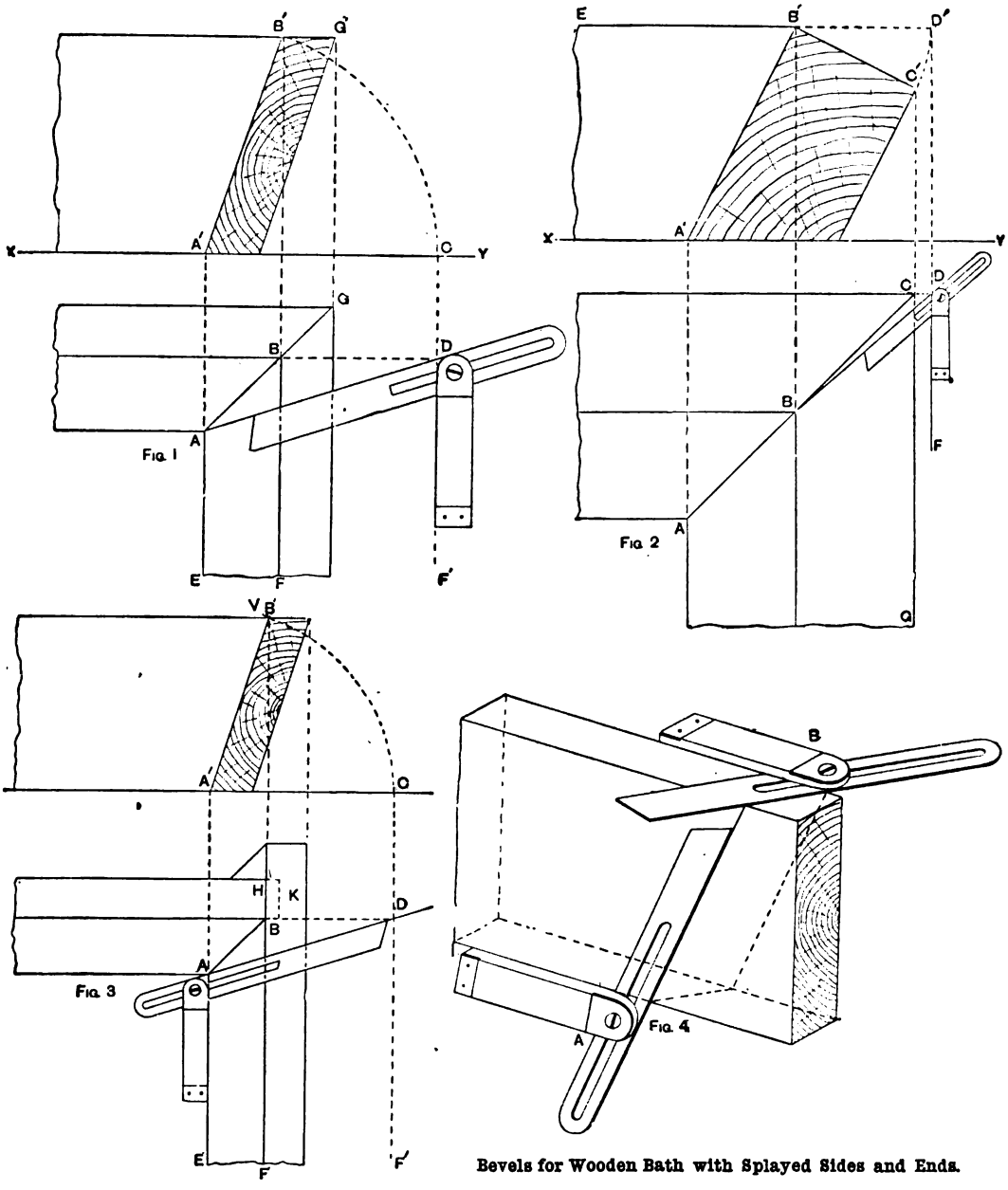
Finishing and Renovating Shop Fittings.—The fitting up and alteration of shops and offices often call for a more expeditious method of finishing the woodwork than is possible by laying on successive coats of paint, graining in imitation of choice woods, or oil varnishing. The French polisher is required to polish the counter top, show cases, desk, and the hand-rail and newels of the stained case; and, if he is conversant with the routine of builders' and shop-fitters' work, he will be able to finish his work, leaving it dry and free from tackiness, in a much shorter space of time than is possible by the use of oil varnishes. The shop-fitter's craft is conducted on such precise lines that it is possible to put in a newly polished shop front, with fascia and name signs all complete, with such exactitude that the polisher is not called on to do much outdoor work. Sometimes the front may be bodied up ready for finishing out when fixed, or the portions more intricate or difficult of access may be finished out before fixing, leaving only the most accessible portions to be done by the out-worker. With builders it is a common practice to build and fit up the woodwork where it is intended to remain. Then the polisher, when engaged on outdoor work, has to run the risk of the weather being unfavourable; and should the polish get chilled and turn white when using, naphtha instead of spirit should be used as a solvent of the gum-shellac and for clearing out purposes. On indoor work all mahogany should be wiped over with red oil, all pine with raw linseed oil. If the front of a counter and its screen partition are to be finished out as pine, with mahogany mouldings, the latter are generally worked out of common quality wood, and should then be darkened by being wiped over with chrome previous to applying any polish. As a rule, pine or red deal goods will sufficiently darken and look rich in colour by the application of polish and spirit varnish. Should it appear too pale, however, a trace of red stain in the varnish will give a warmer tint. Matchboard partitions intended to be finished pine should be coated with glue size to which a small quantity of yellow ochre (dry powder) has been added. Apply with a sash tool, rub well in, and finish off in the direction of the grain with rags. Fill up all nail holes, etc., with putty coloured to match, before applying any polish or varnish. The mahogany work should have the grain filled up with a paste filler of whiting, venetian red, and turps, the polish being applied in the usual manner with pads of wadding, the polish being slightly enriched in colour by adding a few drops of red stain. The pine or deal goods will not need a grain filler, the surface being built up quickly by the liberal use of varnish. Black goods are better if they are finished in the workshops, if they are to be fixtures. A good quality of black stain should be used—one that will penetrate deeply. If possible procure from a drysaltery or paint stores what is known as French black stain. Use polish made from garnet shellac, and colour it an intense black by adding a small quantity of spirit black dye—an aniline dye soluble in spirit. The varnish may also be similarly made black. If a walnut colour is desired on pine goods, stain with walnut stain made as follows:—American potash, 8 oz.; nut galls, 1 oz.; best quality brown umber, 4 oz.; ground in water. Crush the nut galls, mix with the potash and a small quantity of hot water, then add the umber, still mixing. Then add water 1 gal., or as much as will give the tone desired in two applications. Another simple stain is made by dissolving a handful of common washing soda in a quart of water, then adding to brown umber of good quality. For a mahogany finish on pine goods, mix burnt sienna in stale beer and water, equal parts, then using coloured polish and varnish, care being taken to avoid a garish colour such as will result by a too liberal use of stain. If glue size is not at hand where matchboard is required to be finished as pine, a useful stain may be made by mixing raw sienna in stale beer and water.

Liquid for Etching with Rubber Stamp on Glass.—The liquid used with a rubber stamp for etching, say, a name and address on glass, is a mixture of liquids which, until required for use, must be kept in separate vessels. The proportions are sodium fluoride 36 parts, potassium sulphate 7 parts, hydrochloric acid 65 parts, and distilled water 500 parts. The writing will be visible thirty minutes after the solution has been applied.

Cutting Wood Letters.—Large letters for entablatures in wood are made of first quality yellow dry pine without knots. Letters up to 15 in. are cut out of the solid material. The letter is first designed and stuck on the wood. The outer parts are cut with a band saw, the inner parts, which are inaccessible to the band saw, being cut with a fret saw. The circular face is obtained by rounding off the face on either side with a hollow plane, chisel, or spokeshave of suitable shape, and finishing with a wood file and glasspaper. For larger letters, the material is in two thicknesses, the joints being crossed and well glued and screwed together, and afterwards got to the desired shape.

Removing Grease from Varnished Surface.—For removing dirt and grease from a varnished surface, try washing with paraffin—a cupful added to a bucketful of warm soapy water. If this is not strong enough, use liquid ammonia instead—one pennyworth to each gallon of soapy water. Swill off with plenty of clean water.

Bevels for Wooden Bath with Splayed Sides and Ends.—Below is explained how to get the mitre and bevel of the square butt of a small wooden bath, bevelled at the sides. At Fig. 1 is shown the plan when the sides and ends are mitred together, and also section showing the inclination of the sides. To obtain the bevel to apply for the side cut, use A′ as centre, B′ as radius, and describe the arc B′ C to X Y. Project down, making C D F parallel to B F. Project from B to D parallel to X Y. Join A D, which gives the bevel required, as shown. If the top edge of the stuff is to be horizontal, as shown at B′ G′, the bevel to apply to the edge will be simply as shown in plan by B G; but if the edge of the stuff is to be square to the side, as shown at B′ C′ (Fig. 2), the bevel must be obtained as follows:—Produce E B′ to D′, as indicated (Fig. 2). With B′ as centre, describe the arc from C′, which gives the point A′. Project down from D′, making D F parallel to C G, as shown. Project from C parallel to X Y. This will give the point D. Join B D, and this will give the bevel line required. At A (Fig. 4) is shown the application of the bevel to the side of the stuff, and at B the application of the bevel to the edge of the stuff. When the ends butt to the sides, as indicated at H (Fig. 3), the bevel, it will be noticed, is obtained in a similar manner to that shown at Fig. 1. It is not often that simply a butt joint is used between the ends and sides, generally the ends being housed into the sides, as indicated by the dotted lines shown at K (Fig. 3).

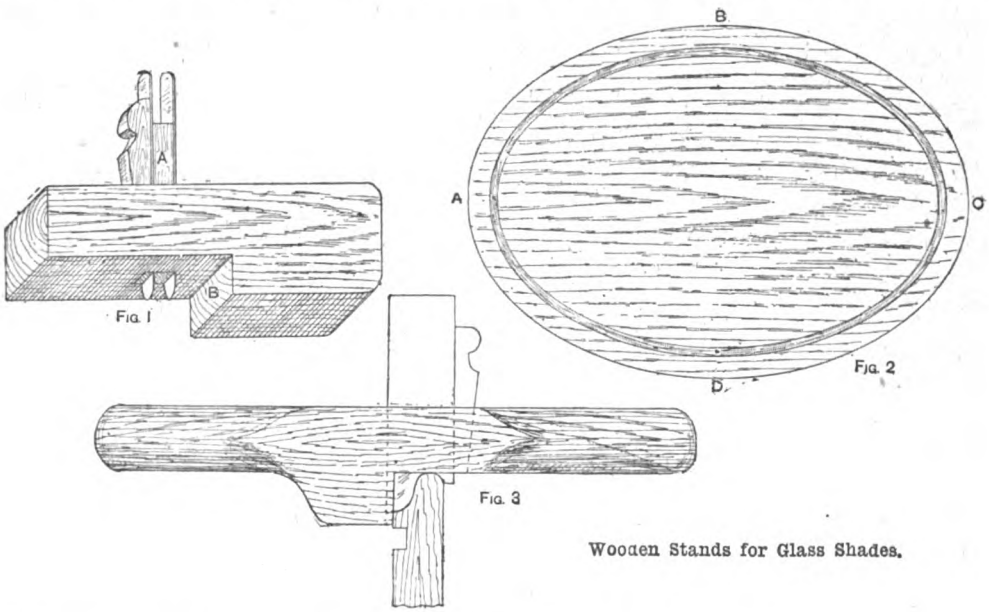


Bevels for Wooden Bath with Splayed Sides and Ends.

White Ink for Rubber Stamps.—The following is a recipe for a white ink for use with rubber stamps: Grind together very carefully 2oz. of zinc white with 1oz. of glycerine; when the mass is homogeneous add 1oz. of methylated spirit.

Locating Leak in Sailing Boat.—In the case of a sailing boat which leaks either at the junction of the centreboard and keel or along the bottom of the boat between the edge of the first plank and keel, the leak can be located in the following manner: the boat should be sponged perfectly dry, and then floated on the water, the junction of the centreboard and keel being closely watched. If there is a leakage the water will be seen trickling through, and such places should be marked with a pencil (so as to denote the exact spots) and caulked with two or three threads of boatbuilder's cotton. Then haul the boat out of the water, put a bucketful or two of water inside her, and carefully examine the keel plank; if it leaks, caulk with a thread of cotton, fill up the seam with putty, and paint the part if the rest of the hull is painted.

Wooden Stands for Glass Shades.—A form of copying lathe is generally employed for making wooden stands for oval and square glass shades, but if it is desired to make them by hand, the wood should be cut out and trued to size and, in the case of the oval stands, the edges trued with a spokeshave. A simple tool for cutting the groove for the shade is shown at Fig. 1. This tool is of hard wood, through which a mortise is made for the reception of two cutting blades—those used for cutting gauges are most suitable. A block of hard wood equal to the width of the groove to be made is placed between the blades as shown at A (Fig. 1), the whole being held firmly in the mortise by the wedge, which may also be of hard wood. The distance from the fence B to the first blade must be equal to the distance of the groove from the edge. This cutting gauge or router, when used for the oval stands, should be worked along the quarter A to B (see Fig. 2), then along C to B, then C to D, and A to D. After working the blades down to the desired depth, the wood between the cuts can be removed with a sharp chisel. The moulding round the edge can be worked with a router, as shown at Fig. 3; this router can be filed from a piece of stout steel scraper. Iron or brass will be most suitable for the wedge of the router.



Wooden Stands for Glass Shades.

Photographs of Moonlight Scenes.—Any paper that produces a blue-green image may be used for printing moonlight scenes by photography. The ferro-prussiate or iron process is the simplest, as the paper merely requires printing and washing. The paper, which is very cheap, may be procured of any dealer in photographic materials. The carbon process (the most permanent known) is the one that is most suitable for producing moonlight effects, as any pigment may be used, and the colour can therefore be mixed to the exact tint required. The process is one that requires some little skill. The paper, which can be purchased sensitised, is quite black, and the exposure must therefore be timed with an actinometer. The paper is then squeegeed down on ground opal and washed with hot water until the sensitised preparation covering the lighter parts of the picture dissolves away and the image appears. The print is then immersed in alum and washed. The gelatine film is finally transferred from the opal to a gelatinised paper by bringing the two in contact under water; the water should be hot. When dry, the paper, together with the film, will peel off from the opal. Rather strong but not dense negatives are as a rule desirable for this process. By the following method very fair moonlight effects are produced on bromide paper:—A very light bromide print is toned in uranium nitrate 20 gr., potassium ferricyanide 20 gr., acetic acid 1 dr., water 10 oz., to a fairly bright red. The print is then transferred to a weak solution of perchloride of iron; in this bath the print will instantly become a blue-green.

Japanning Brush Stocks.—Stoving japan suitable for wood cannot be satisfactorily made without the aid of costly appliances and a knowledge of the various qualities of gums, etc. The ordinary enamel paints as sold in tins for domestic purposes are useless for stoving. The foundation of brush stocks is generally a mixture of glue size and whiting. This, when dry, is smoothed with pumice. The japanning stove must be heated to a temperature of from 250°F. to 300°F., the goods remaining in the stove sufficiently long to cause the gum to liquefy and adapt itself to all inequalities as the solvent flies off. A knowledge of how long the goods should remain and the exact heat required can be gained only by experience. As a rule, the goods remain in the stove overnight, the doors being opened early next morning to allow the goods to get cold before handling.

Transferring Designs to Cloth.—Resin, coloured by the addition of ultramarine, venetian red, or other pigment, is used for transferring designs to cloth. The design is cut as a stencil in thin sheet zinc; the coloured resin should be powdered and shaken from a flour dredger equally all over the stencil, which is placed on a sheet of white tissue paper. A hot iron is run over the stencil, thus forcing the resin through the design on to the tissue paper, to which it adheres. If the paper is now placed, design side down, on cloth, and a hot iron run over, the design will adhere to the cloth. Line designs are the best.

Riveting Watch Balances.—A plain steel stake with a row of holes in graduated sizes is used for riveting on watch balances. The cylinder collet is turned so that the balance goes tight down to a flat seating turned to receive it. The brass of the collet should rise a very little above the balance and the riveting face should be turned hollow, leaving the edge standing up ready to be riveted over. A hard steel punch shaped like a crescent is used, the cylinder and balance being turned round a little at each blow. For riveting wheels on pinions, a flat punch with a hole in the centre is used. A staking tool and set of punches is very convenient.

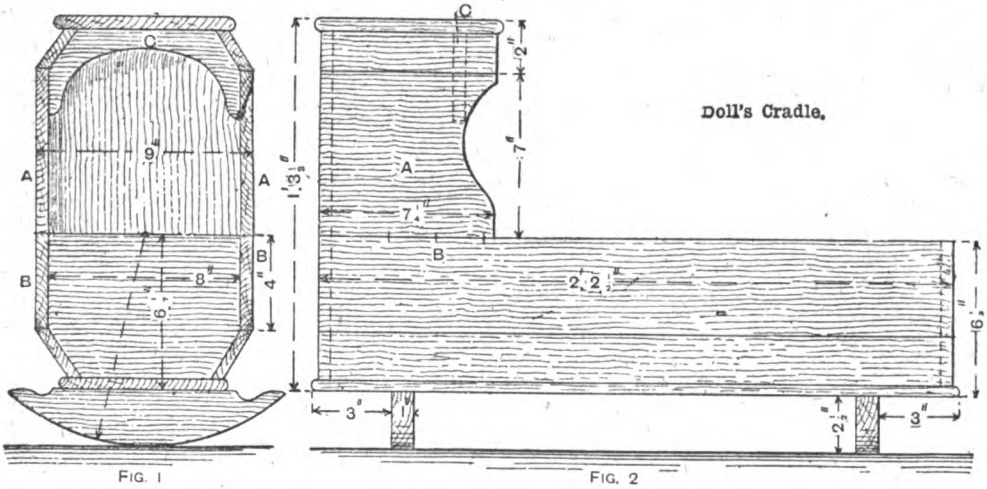
Calculating a Watch Train.—Often it is necessary to calculate a watch train so that a hairspring of suitable strength can be fitted to the watch. In nearly every case, when the fourth wheel has eight times as many teeth as the 'scape pinion has leaves, the train is 14,400, giving ¼ seconds. When the wheel has nine times as many teeth, the train is 16,200, beating 4½ per second; when ten times as many, the train is 18,000, beating ¼ second. To calculate a train, multiply together the numbers of teeth of the centre, third, fourth, and 'scape wheels, divide the result by the third, fourth, and 'scape pinions, and multiply the result by 2. This gives the number of beats per hour. This result, divided by 60, gives the number per minute.

Loading Sporting Gun Cartridges.—In loading cartridge cases, the apparatus required must be considered. For from 25 to 50 cartridges, a loading tube with rammer and block and a turnover are all that are needed; or a loading and turnover machine can be obtained, and if it is intended to reload the cases, a loading turnover and re-capping machine may be employed. An E.C. Schultz and black powder and shot measure combined will be required, or they can be had singly, one for shot and another for powder. Pour the powder into one basin and the shot into another; then place the cases into the tube and fill them one after another with powder. Next put in the waterproof wad and card wad edgeways, as the greased pink-edged felt wad over it will bring it straight. The two must be pushed down together, care being taken to seat them firmly, but nothing more. Then put in the shot, placing the card wads level over the powder so that they will be ready for the turnover, which can be screwed on the table. For loading cartridges, Schultz powder may be recommended as one of the safest; 42 gr. of it equal 3 dr. of black powder. Further, although 1 lb. of Schultz powder has about double the bulk of black powder, the latter will load only half the quantity of cartridges; in addition, with black powder greater velocity and greater penetration are obtained, and, from a gunmaker's point of view, powders with excessive velocity put too great a strain on the guns. When using Schultz powder, ram it home till firm, but do not apply great pressure. Chilled shot is the best to use, No. 6 being about the most useful size, the charge for No. 12 cartridges being 42 gr. of Schultz to 1¼ oz. of chilled shot.

Cardboard Panels.—In the construction of fire-screens and other frail furniture in which thin panels are required, it is often difficult to obtain the wood sufficiently wide without the trouble of jointing up; further, as in many instances these panels are profusely decorated, a cheaper substitute is often sought, glass and metal being often used. It may be useful to know that stout cardboard or millboard can be used with equally good effect. For instance, an overmantel may be fitted with a stout cardboard panel stained in imitation walnut, an oval opening for a mirror being cut out with a fine pad saw. Strips of wood glued on behind form a recess for the reception of the glass, and give all the support required to prevent buckling or sagging. The cardboard can be made to correspond with its surround, if this is of walnut, by first applying a coat of spirit varnish, then mixing brown umber (dry powder) in 1 part varnish, 3 parts spirit, and applying several coats, using a camel-hair brush; smooth any roughness with fine glass, and apply another coat of varnish. The surface thus gained could, when dry, be French polished, or, if desired, is ready for any decorations—painted, fixed with varnish, or transfers. For a mahogany finish, build up the ground-work with venetian red, varnish, and spirit; for a black ground, apply successive coats of spirit black enamel.

Cement for fixing Ivory on Keys.—Finest quality transparent glue, with the addition of a little flake white, is generally used in the trade for fixing ivory or bone on musical instrument keys. The surfaces of both key and ivory should be roughened, the glue applied hot, and the two tightly cramped together for several hours; they may also be tightly bound with string, a wooden wedge being forced between the string and ivory to ensure closer contact. Fish glue is useful if only a few keys are to be finished. The keys should, if possible, be removed from the instrument during the operation of fixing.

Doll's Cradle.—Fig. 1 shows the front elevation and Fig. 2 the side elevation of a doll's cradle. The wood



Doll's Cradle.

FIG. 1 FIG. 2

is ½ in. thick except for the rockers, which are 1 in. thick. The side A of the head is secured to B by glue and dowel nails. A piece of wood C is fitted inside the head to give strength.

Pyrometers for Recording Temperature of Oven.—There are several forms of pyrometers suitable for taking the temperature of an oven. Murrie's pyrometer has a bulb and tube attached to a dial or indicator round which a pointer moves as the temperature varies; the bulb must be inside the oven, but the dial is fixed outside. There are also electrical pyrometers, invented by Siemens, Austen Roberts, etc.; these record high temperatures either by the alteration in the resistance of a wire, placed in the oven, to a current of electricity passing along it, or by the generation of a weak current of electricity by the heat in a compound wire or couple, which current is measured and its strength recorded. These pyrometers will record any temperature up to the fusing point of platinum; they are used as a rule for high temperatures, and are expensive.

Enamelling Leather.—In preparing enamelled or patent leather, stretch the skin on a board and remove every trace of grease by thoroughly washing and rubbing. Mix and boil to the consistence of single size 1 oz. of Prussian blue and ½ gal. of drying oil; when cold add a small quantity of vegetable black. Spread some of this mixture lightly and evenly over the surface of the skin, and then place in a stove heated to 120° F. for about six or eight hours. When the varnish is dry, lightly polish with very finely powdered pumice-stone. Apply a second coat in a similar manner to the first, then give a third coat, but this time boil the varnish till it thickens and strings well. For the last coat, add a little amber varnish and enough vegetable black to give the shade required.

Making Sails for Yacht. — In sewing together the cloths of yacht sails the seams of the cloths are laid so that one cloth overlaps the other by about ⅜ in. or 1 in.; the cloths are then basted together to keep the seams parallel, and two rows of machine stitching are run in, one at the edge of each cloth. The roping is generally put on the starboard side—that is, the right-hand side looking from aft. The reef points are cut to the exact size, allowing sufficient length for both sides of the sail. A hole is then made in the sail with a marlinespike, and the point rove through the hole until the sail coincides with the centre of length of the point, when it is stitched to the sail with a sailmaker's needle and twine. The sails ought to be thickened at all the corners—that is, at the tack, clew, peak, and throat.

Design for a Porch.—The accompanying illustrations (Figs. 1, 2, 3, 4, and 5) show designs for a porch constructed

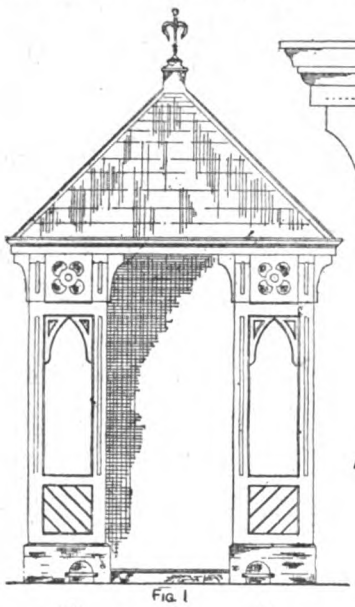


Fig. 1

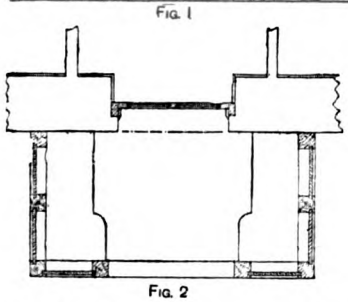


Fig. 2

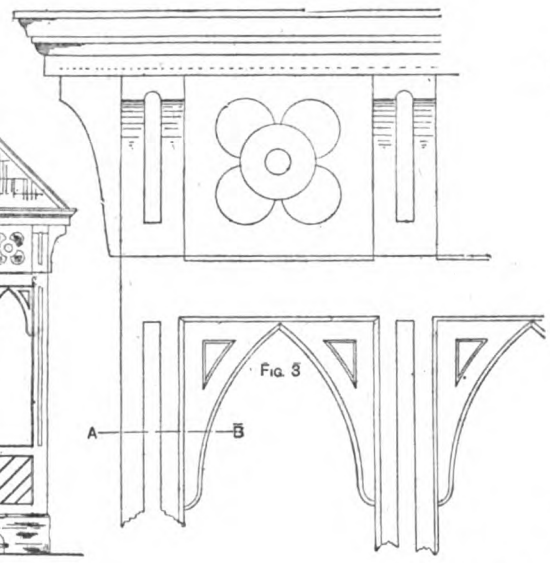


Fig. 3

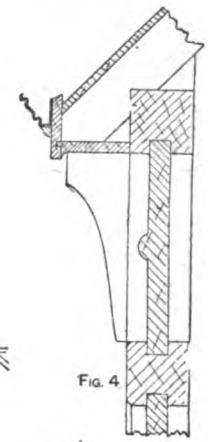


Fig. 4

Fig. 5

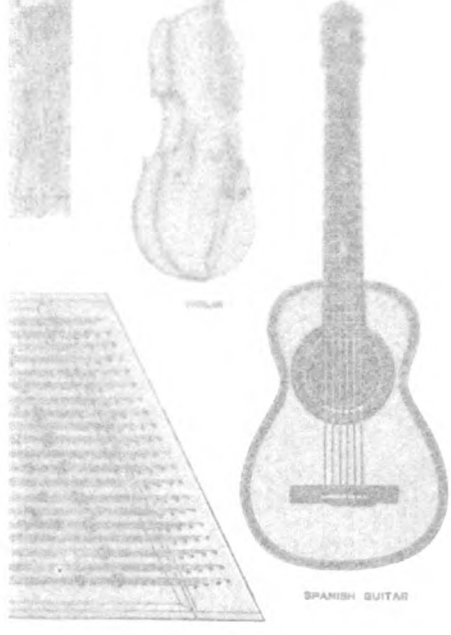
Design for a Porch.

wholly of wood, and having a slated ornamental roof. The floor of the porch is tiled, the step at the entrance being checked at the back to receive them. A seat is placed on two sides of the porch (inside). Fig. 1 shows the front view, Fig. 2 the plan, Fig. 3 a detail of half the side, Fig. 4 a section through the eaves cornice, and Fig. 5 a section through the line A B (Fig. 3). The illustrations are sufficiently clear to explain themselves.

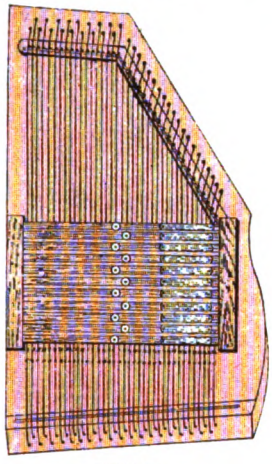
Setting up Tufts of Upholstered Chair-back.—For setting up the tufts of an upholstered chair-back that does not require much set, such as a cabriole or balloon back, the squab is very lightly stuffed; it must on no account be hard, as this will prevent the buttons sinking and setting up the tufts. The button strings are put through and, before being tied off, a sharp-pointed regulator is passed through the back cover and worked about freely until the stuffing round the strings is worked away, leaving a hollow space; the strings are then pulled in tight and the button sinks, bringing the cover down and throwing up a tuft all round. The strings must be tied tight and secure. For deep lap tufted backs, each tuft is stuffed up separately, commencing in the centre and gradually working to the sides. The creases between the tufts are set in by tapping them with a hammer whilst laid on a piece of hardwood; care must be taken to have all the tufts of the same height. A common practice in tufting is to leave the ends of the twine long enough to reach to the stuffing rails, knock a tack halfway in the rail, pull the strings tight and lap round the tack, which then is driven home; this, if properly done, gives the buttons a permanent set. The stuffing material has much to do with the set of the tufts; hair and other springy fibres set up much better than flock or similar short stapled materials.

Mounting Platinotype Prints in Optical Contact.—Below is described a method of mounting platinotypes in optical contact. Dissolve 1 oz. of No. 1 (Nelson's) gelatine in 10 oz. of water, and whilst warm immerse the print in the solution. Place the glass in warm water, and after a few moments' immersion transfer the glass to the gelatine solution, and while both are under the surface bring the face of the print in contact with the larger surface of the glass. When removed from the gelatine the print should be covered with a sheet of fluffless blotting paper and stroked gently into contact, thus squeezing out any air bubbles that may have lodged between the print and the glass. The prints should, before mounting, be trimmed slightly smaller than the glasses to allow for the stretching that occurs when the prints are wetted. Bear in mind that the narrow way of the sheet, however the paper may afterwards be cut, is the direction in which the paper stretches most. When dry, the strut may be glued on as usual. It may be mentioned that platinotype prints are not at all suitable for mounting in contact with glass. The beauty of the platinotype consists in the softness and pleasing gradation of the matt surface of the print, which is entirely destroyed by the treatment described above.

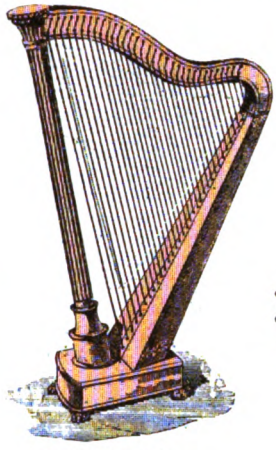
Non-slipping Pad for Sole of Pin-leg.—A non-slipping pad for the sole of a pin-leg is a roll of thick sheet rubber inserted in a cup fixed to the base of the pin. This cup is a 3-in. length of stout brass tube fitting the pin, to which it is secured by short screws. As the pins in general use have only a shallow base unfitted for this addition, it is necessary to have a new pin made for the brass foot. Then get a piece of ⅛-in. vulcanised sheet rubber wide enough to fill the cavity, and leave ¼ in. of rubber (end grain) protruding to form the pad. Make a compact roll a little too large for the brass cup and compress it by winding whipcord around it tightly until one end just fits the tube. Screw the roll into the tube, unwinding the cord at the same time, until all the rubber roll is pressed in. A heavier weight than usual coming on the pin will be taken by the brass, which also aids in obtaining a grip on slippery floors, as its sharp edges prevent slipping. The brass should be enamelled black to match the leg.


SPANISH GUITAR

MUSICAL INSTRUMENTS.

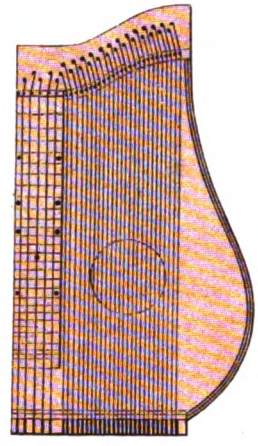


AUTOHARP



FULL-COMPASS HARP

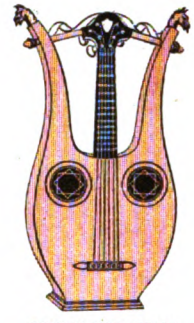
PICCOLO BANJO



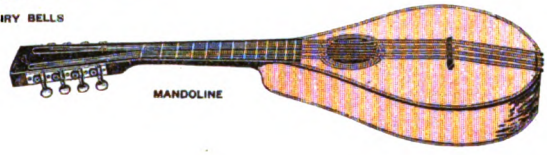
ZITHER

FAIRY BELLS

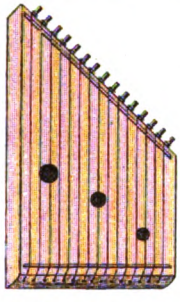
FLUTE



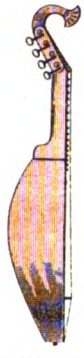
SPANISH LYRE GUITAR



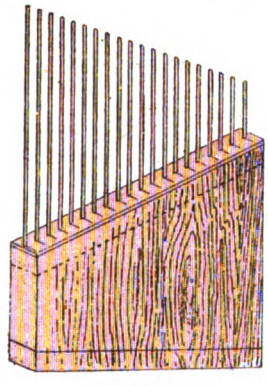
MANDOLINE



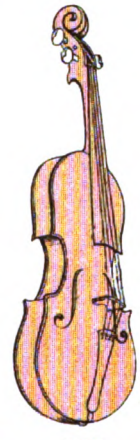
PRINCE OF WALES' HARP



FLAT-BACKED MANDOLINE

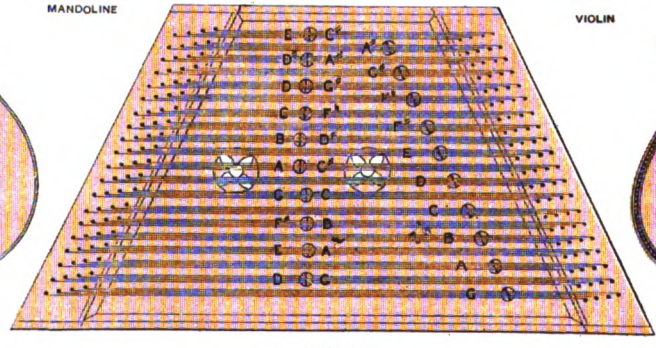


MARLOYE'S HARP



VIOLIN

PORTUGUESE GUITARRA



DULCIMER

SPANISH GUITAR

CASSELL & COMPANY, LIMITED, LITH. LONDON.

Renovating Furniture Leather.—To revive furniture leather, with a lukewarm solution of water and soda cleanse the surface of the leather from dirt and grease. Then rub on the flaked parts a thin paste of boiling water and rye flour, and lay the loose scales down by stroking with a large bottle cork. Before the paste is dry, remove the excess with a wet sponge or rag. When thoroughly dry, the leather can either be varnished or dressed. A varnish that gives a semi-lustrous appearance is made from ½ pt. of methylated spirit and 1 oz. of bleached shellac. Allow this to dissolve, then add the whites of two eggs; this solution should be applied with a soft rag swab or sponge. The solution should be stained the colour of the leather with aniline dye soluble in spirit; the parts that are most bare can be touched up with several applications before the whole surface is varnished. If the leather is much worn make up a dressing as follows. Dissolve in a water bath 1 oz. of borax and 2 oz. of shellac in 1 pt. of hot water, and strain through a fine sieve or muslin; whilst hot, add ¼ oz. of dye of the required colour and ½ oz. of glycerine; well shake before using, and apply with a swab.

Bread-cutter and Slicer.—Fig. 1 shows a bread-cutter and slicer complete. The base, a half plan of which is shown at Fig. 2, is of wood. The bottom stand is of 1¼-in. well-dried beech or birch; the upper stand, which is bolted to the lower one, should be of 2-in. beech or birch. Any white wood of close grain, such as sycamore, may be used. The upper fittings (see Fig. 1) consist of a central standard with an opening ¾ in. wide; this is the guide for the knife. At the foot of the standard, which is fixed to the lower stand with bolts and nuts, is the gauge. This is screwed to the side with a hexagon screw and nut, and regulates the thickness of the slice of bread to be cut. This standard may be of wood as shown in Fig. 3, and tenoned into the bottom stand, but it will be better if made of iron. A cast-iron slide at the end of the stand (see Fig. 1) has sliding up and down it a pin to which the end of the steel knife is fastened. The handle end of the knife is secured to a lever piece of iron working on pins and sockets, and fixed to the bottom stand with a hexagon nut and bolt. At the top of the lever a handle is fixed at an angle as shown in Fig. 1; this gives the motion to the knife of cutting down and across. The wood block at the end of the stand is for the lever of the knife handle to fall on. The knife should be of best steel and truly ground.

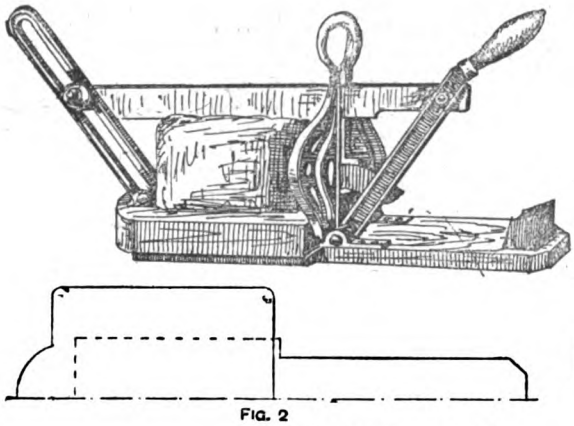


FIG. 2

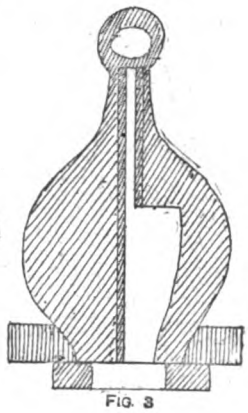


FIG. 3

Bread-cutter and Slicer.

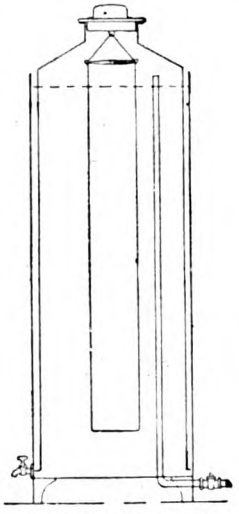
Black Finish for Wooden Articles.—There is nothing more durable than black japan; the coated articles are placed in an oven or stove, and maintained for some time at a temperature of from 250° to 300° F. The solvent of the resins and gums is driven off, and the residue becomes liquefied, and thus more readily adapts itself to inequalities, the varnish sinking into and amalgamating with the wood fibres. Thus, if two or more coats are applied, each being stoved, a surface is built up that wears well and retains a gloss for a long period, brush handles, tea trays, and metallic bedsteads being treated in this way. For ordinary work the gloss left by heat is sufficient, but high-grade goods are sometimes finished with rottenstone and washleather. To prevent twisting by the heat, thoroughly seasoned wood should be used, being coated with a mixture of glue size and whiting or of ivory or Frankfort black in thin spirit varnish. Several coats may be given, and the surface then smoothed with pumice before applying the japan, which is best procured ready made from varnish makers. If the number of articles will not justify the outlay for a japanning stove, etc., a good result may be gained by French polishing, but to guard against the possibility of white wood showing when the polish wears off it is advisable to stain the wood deeply with ebony stain; French black stain, procurable from wholesale druggists and paint stores, gives good results. The polish should be of a hard variety, and applied by a pad throughout. Varnish, if used at all, should be of good quality, containing only a very small percentage of resin or soft gums; apply it with a camel-hair brush in a warm room after the work is well bodied up with black polish.

Re-painting a Governess Car.—If the old paint on a Governess car is cracked it should be removed, or it will not be possible to make a good job; but if the paint is in good condition well glasspaper it down all over, and give the body a coat of colour made up of lampblack, purple brown, and deep chrome, with gold size as a drier, and thinned with turpentine; this is supposing that a walnut finish is required. This coat should be made up rather light, the next coat being made much darker, using the same ingredients, but in different proportions; then, when the dark coat is put on the light one, a resemblance to the grain of walnut can be given by using a dry duster brush on the top coat. For the wheels, springs, and shafts, give a first coat made up of tub white lead, driers, and rose pink; afterwards give two coats of Chinese red. For a superior finish vermilion should be used, the last coat on both the body and shafts, etc., having in it a good proportion of varnish. Before lining out, the whole of the work must be flatted down; full instructions on doing this, also on lining out, are given on p. 71. For picking out, use finely ground drop black thinned with gold size. Hard-drying or under-coating varnish should be used for the first coat; this is allowed to harden, then a full coat of finishing varnish is given. Be careful to use carriage varnish for the wheels, etc., and body varnish for the body.

Bushing Piano Keys.—For bushing the front pin-holes of piano keys, a tool similar to a short, stout screwdriver is required. Sharpen and shoulder one end of a piece of brass or iron about 4 in. long, ⅜ in. wide, and ⅛ in. thick, insert it in a short handle, and file the projecting part slightly taper till it just fits into a hole that is already bushed. Procure a strip of red bushing cloth, and cut it into strips of convenient width and slightly longer than is required. Bend a piece of the cloth over the point of the tool, touch the outer sides with thin hot glue, and press at once into position, insert the overhanging ends in the channels by the side of the mortise, trim off the surplus, and press well home so as to give a neat appearance. If the centres are to be bushed, cut the cloth lengthwise of a convenient width, then, for convenience of handling, cut it into pieces about 9 in. long, cut the points to a sharp angle, twist to a point, touch with glue, insert in the hole, and pull through, setting it close to the sides of the hole by passing a taper bodkin through; or the tail end of a tuning fork may be used.

Clock Gong.—The making of clock gongs is a trade to itself, and an amateur is not likely to succeed in making a good one at first. First the wire is brazed into a brass end block, then coiled up into a spiral, and then heated to a bright red evenly all over and hardened. It is next polished, then blued by heat. A gong of round wire is the easiest to make. For a grandfather clock gong, procure a round steel rod $\frac{3}{16}$ in. thick and 45 in. long. After brazing it to its block, about 1½ in. by ⅝ in. by ⅛ in., coil it into a spiral of about three turns and 7 in. outside diameter. To harden the steel, heat it in a forge fire and plunge in water, then polish with fairly quick-cutting emery and finally with the finest. Then blue it in burning charcoal dust or hot sand on an iron plate over a fire.

Acetylene Generator.—The accompanying sketch illustrates an acetylene generator which may have a height of about 3 ft. A cylindrical tank, open at the top, has in it another cylinder open at the bottom; this makes an ordinary type gas-holder. The top of the inner cylinder, or bell, has an opening with a gas-tight cover, and suspended from this cover is the perforated carbide holder, as shown. The gaspipe stands inside, and an



Acetylene Generator.

emptying or cleansing cock is needed near the bottom as indicated. There should also be a small cock at the lowest point in the gaspipe, as water may collect there. The piping in the house is done as for ordinary gas, except that it may be smaller. For four lights a ½-in. supply pipe is ample. The gas fittings should be of good quality, as acetylene will leak out of a smaller place than coal gas. The generator may be, say, 3 ft. high and 1 ft. in diameter, external measurements.

Oxidising Watch Cases.—Silver watch cases may be oxidised by the method given for ordinary silver on p. 55, Series I. Steel watch cases are oxidised by heating them to a bright red in an oven and passing steam over them. Gun-metal watch cases may be oxidised by simply heating in air, but the so-called oxidation may be brought about by treating the metal with alkaline sulphides or with certain metallic salts such as antimony chloride, etc.; these produce superficial films of a sulphide or of a reduced metal.

Sewage Pump worked by a Windmill.—A common cast-iron pump with the handle removed and a connecting rod fixed from the mill crank to the bucket rod of the pump would answer for raising liquid sewage from a tank 6 ft. deep by means of an existing windmill, which can be altered from a 4-in. to a 6-in. or 8-in. stroke at will. The pump should be fixed at the base of the mill so that the rod works vertically and the suction pipe may be continued to the sewage tank if not too far distant. The pump, if fixed at one side of the mill, can be worked by means of a bar or beam mounted near the centre on an axis, the rods from the mill crank and bucket respectively being attached to the ends. The suction pipe should have a large strainer on the bottom end, and this should be kept up about 1 ft. from the bottom of the tank, so as to be above the sludge, which would otherwise be drawn into the pump and clog the valves. If convenient, the pump should be stopped just before the floating scum on the top of the sewage is lowered down to the holes in the strainer. The pump should be so fixed that it can readily be taken out for repairs or the removal of obstructions. A chain pump could be used, but it would be necessary to make alterations to the windmill, so that the rotary motion is transferred to the pump. A fly-wheel on the pump would help to steady the motion, but would perhaps be objectionable if the mill sails are not self-setting to counteract sudden gusts of wind.

Weather Indicators.—The weather indicator here described depends for its action on the contraction or expansion of a cord with an increase or decrease respectively in the moisture contained in the atmosphere. First procure a board 18 in. or 20 in. long and 12 in. wide, a dozen very small empty silk-reels, and smooth French nails, and three or four knots of the finest uncoloured whipcord. Fix the reels by nails as shown in Fig. 1, and then to A secure one end of the cord and pass it over the reels from side to side as shown over the last one B. To this end of the cord fix a flat 4-oz. lead weight to keep the cord in tension. It will accordingly rise and fall with the humidity or dryness of the weather, thus

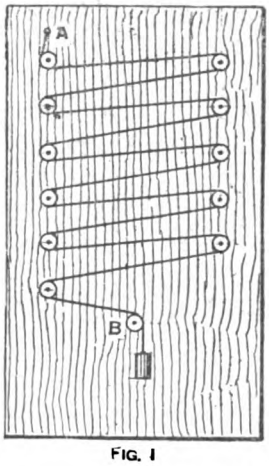


FIG. 1

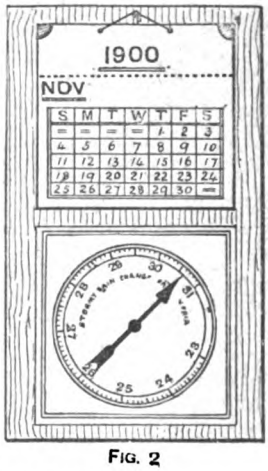


FIG. 2

Weather Indicator.

turning the last reel B. A cover of the same size as the board has sides and top to fit just clear of the reels, and an index of cardboard has on it the usual words—Change, stormy, fair, etc. Through a central hole fix a small tube to B, and on to this mount friction-tight the hand or index finger made of very thin metal (copper or tin) and coloured dark blue or black. A neat gilt frame to fit round the dial improves its appearance, and above in the blank part hang a calendar. The above is an adaptation of an old form of hygroscope, and in one case an instrument on this principle was at work in a long passage for years. One end of a thin gut cord was fastened to a hook near the ceiling and the gut passed over a pulley at the other end—some 30 ft. away. A 2-lb. weight hung about half-way down to the floor. Its range was considerable, and as there was only one pulley—a fairly large one with a small axle—the friction was almost nil, and the instrument was very sensitive to the variations in the amount of moisture present in the atmosphere. The barometer, of course, tells only the variations of pressure, and in this case the markings on the common pattern of barometer are really useless. To be of real use as a prognosticator the barometer must be stripped of its words; its inches and tenths are more useful, but the instrument must be studied in conjunction with the hygroscope and the thermometer.

Magnesia Cement.—The chemist knows only one kind of magnesia, magnesium oxide. A pharmaceutical chemist or druggist sells three substances under the name of magnesia; one, calcined magnesia, is magnesium oxide; the other two are carbonates. Magnesia, mixed in the proper proportion with magnesium chloride, forms a hard white mass in a few hours, and may be used as a quick-setting cement; the mass should be made into a moderately stiff paste to obtain the best result.

Wrought-iron Tubes. — The three qualities of wrought-iron tube are steam, water, and gas tubes. Gas tube is never used for steam or water work. Steam quality tube is used for steam work, and also chiefly for hot-water work, both heating and supply. Water quality tube, however, is quite good enough for hot and cold water. Steam tube is distinguished by its being painted a dull red. Gas tube is unpainted. The difference in the three kinds is in the thickness of the metal. Lead pipe is mostly used in the south of England for cold water, and is quite safe and serviceable in all districts where the water is not very soft. To bend wrought-iron tube, it is made red hot in a forge at the point where the bend is to come. Then, by means of a vice or arrangement of bars placed under the bench, the pipe is fixed in position and bent, but only a little at a time or it will buckle or flatten, and the flattening cannot be remedied. A slight degree of flattening, however, can be hammered back.

Use of the Vernier and Ventometer in Sighting Rifles.—In using the vernier in sighting a Lee-Metford rifle, it is necessary first to find by practice the proper position of the slide bar for a given range, say 600 yd. Then apply the vernier so that its slide touches the lower edge of the slide bar of the back sight, read the register of the vernier, and make a note of it. On any future occasion it will be necessary only to adjust the vernier to the known register or elevation, apply it to the back sight, and slide the bar of the latter up or down till it coincides with the slide of the vernier, and the correct elevation for the range is known. The principle of the ventometer is similar to that of the vernier, except that its action is horizontal instead of

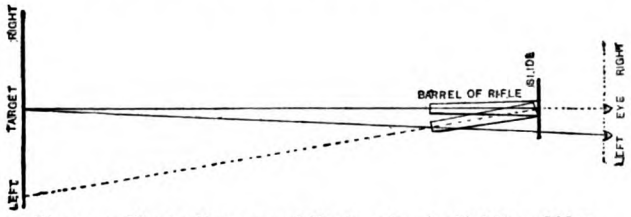


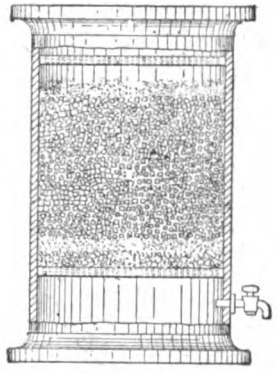
Diagram Illustrating use of Ventometer in Sighting Rifles.

vertical. It consists of an adjustable slide bar which can be fixed on the back sight of a rifle, and it slides right or left by the action of a finely threaded screw. The degrees on its scale represent the distance from the centre of the object to the point at which the muzzle of the rifle will point, if the line of sight be taken along the foresight through the V still pointing apparently towards the object aimed at (or centre of target); for example, if in the judgment of the marksman the deflection of the bullet caused by a side wind would be 4 ft. to the right, at say 600 yd., the slide of the ventometer would be moved to the left a distance on the scale sufficient to bring the foresight 4 ft. from the centre of the target when looked at through the V of the slide. In moving the V of the slide to the left, a wind coming from the left, and consequently deflecting the bullet to the right, is counteracted and *vice versâ*. The accompanying sketch illustrates the principle of the ventometer.

Concrete Cow-bed. — The concrete for a cow-bed may be made with granite macadam of 1½-in. gauge, mixed with 1 part of Portland cement to 2 parts of sand, and laid about 5 in. thick. A chequered surface may be given to a finer concrete in the following manner. A bottom layer 4 in. thick of broken brick or stones should be laid dry and levelled; then pour on it a grouting composed of equal parts of Portland cement and sand, made into a thin mortar with water. When this has set, but before it has become quite hard, put on a finishing coat, 1 in. thick, composed of 1 part of limestone chippings of ¼-in. gauge mixed with 1 part of Portland cement and 1 part of sand. As this would set with a smooth surface, too slippery to afford a foothold, grooves may be indented in it while the concrete is soft by pressing the sharpened edge of a board in it, thus dividing the surface into squares that may have sides say 4 in. long.

Re-covering Head of Carrier's Van.—If the head of a van to be re-covered is boarded all over, use one of the prepared canvases which are made for the purpose; they are made up to 72 in. wide, and range in price from 4s. 6d. per yard for plain back to 6s. per yard for prepared back, both outside faces having japanned surfaces. To put it on, clean off all the old covering, and see that the joints in the roof boards are level and do not work. If they move, put a half-round batten on the inside, give the head a good coat of paint, and if plain back material is used, when the paint becomes "tacky," put the covering on, pulling it well down all round, and tacking along the bottom edges and front and back. Use a pair of pincers with a bent jaw to get it tight. If canvas that is dressed both sides is used, the paint on the head should be allowed to dry and the material warmed before it is put on. If possible, do the head in a warm place, so that the material may be put on tighter. A cheaper method is to cover with moleskin; when the coat of paint or smudge is fairly wet this is put on and well rubbed all over, to absorb the paint. When dry, it will require several coats of paint to get a surface and to make it waterproof.

Water Filter.—The illustration shows the section of an ordinary filter. These filters are made of earthenware salt-glazed, are cylindrical in shape, and have a hole at the bottom for the tap. There is first an earthenware partition perforated with small holes; upon this is placed a layer of clean gravel, then a layer of silver sand, a layer of coarse animal charcoal, another layer of sand, and finally another earthenware partition with holes. Commercial filters deviate more or less from this pattern; in some the filter material is polarite, magnetic carbide, or spongy iron; other filters are made from fine porous



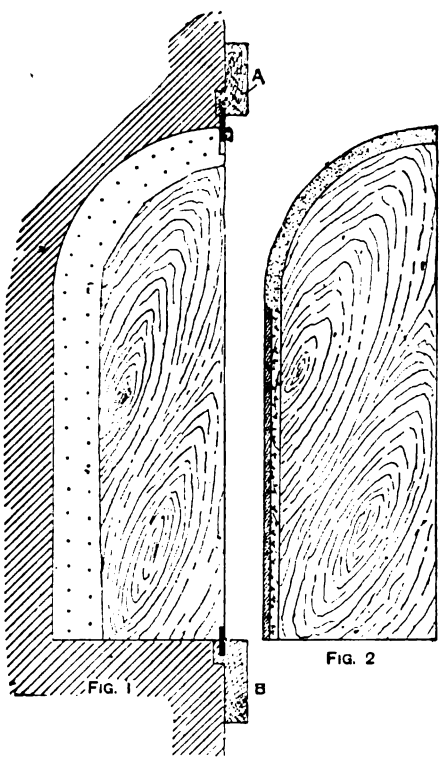
Section of Water Filter.

clay and kieselguhr sufficiently open to allow water to pass through, but not enough to allow the passage of any suspended matter, even bacteria being retained; appliances constructed on this principle are known as Chamberland or Pasteur filters.

Corrosion of Steel and Iron.—It is well known that steel and iron, if exposed to atmospheric influences, and especially in the vicinity of the sea, rust pretty rapidly; not only is the outer surface of the metal attacked, but the rust penetrates to a greater or less depth, and the metal becomes soft like graphite. The sectional area of the joist is certainly reduced, but it is the substance of the joist that is weakened most, owing to the penetrating action of the rust, which is commonly of a very patchy character. If the steel is properly protected with paint there should be no rusting of the metal; but if, on the other hand, moisture can penetrate the layer of paint, rusting begins, but it goes on more slowly than if the steel were unprotected, and the layer of rust is harder and more compact. It is unlikely that galvanic action is set up when iron is painted with lead and oil (meaning, of course, white lead and oil), unless metallic lead is present in the paint, which, however, is scarcely probable. According to some writers, white lead and oil paint is the best protective coating for iron, oxide of iron paint not being so good; but others state the contrary; many experiments have been made to settle this debated question. Neither oxide of iron nor white lead exhibits much electrical action, and the statement in Rivington that an oxide of iron paint applied upon a lead and oil priming sets up galvanic action is doubtful. If in such circumstances there is more corrosion of metal than with a lead or iron paint alone, then the statement would be correct, but, it is believed, experiments to verify this assertion have not been conducted. The precise action of paint on iron is obscure at the present time; but it is evident that a great deal depends on the quality of the paints and the purity of the oil used in making them.

Dyeing Sheepskin Orange Colour. — Sheepskin which is to be dyed an orange colour must be washed thoroughly in warm soap and water to remove any grease or dirt present, and afterwards rinsed in clean warm water. The skin should then be placed in a dye bath made by dissolving 1½ oz. to 3 oz. of any aniline orange in 1 gal. of warm water, and adding a few drops of dilute sulphuric acid. After remaining in the bath, which is kept at a temperature of about 170° F., for half an hour, the skin is removed, dipped into cold water, and wrung out and dried. The dye may be bought in packets from a chemist. It will be advisable to first try the dye on a little white wool to see if the tint is suitable.

Semicircular Niche Head.—Fig. 1 is a vertical section through the centre of a semicircular niche head with a running mould fixed in position. Blocks of wood A and B are secured to the wall, and from these blocks the mould is swung. Fix the blocks in position, taking care

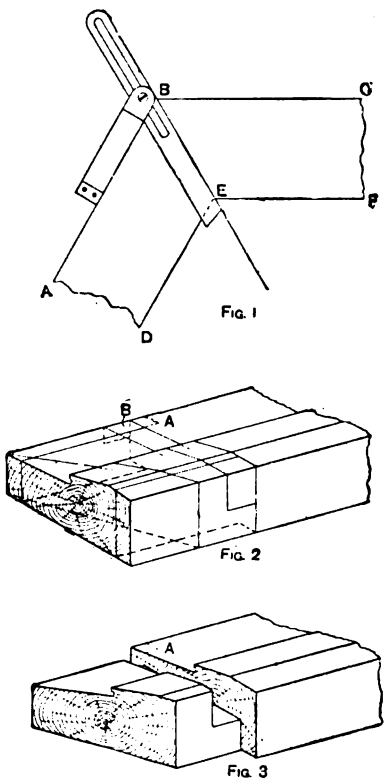


Semicircular Niche Head.

that the sockets are exactly in a line with the face of the wall and with the centre of the niche. A zinc template is cut to the shape of a vertical section of the niche and tacked on to the board as shown in the illustration (Fig. 1). An iron pivot is attached to the lower part of the mould to fit into the socket at B, and a bolt to fit the upper socket at A. When the mould is placed in position, with the pivot in the socket B, the bolt is pushed up, and the mould is ready for work. Fig. 2 shows the opposite side of the mould, and explains the manner in which the edge of the zinc template is bevelled on to the board. The board is sawn to the required shape, with the edge roughly bevelled, as shown on the lower part of the illustration. The zinc template is then cut, and tacked on to the opposite side of the board, allowing about ¼-in. projection all round. A few tacks are then driven into the bevel on the board, and plaster applied, thus making a clean and sharp bevel at the working edge of the mould.

Electrical Depilatory.—Electrolysis of the hair follicle is easily effected with a current of 5 milli-amperes, to be obtained from five Leclanché cells in series, which should give a pressure of 7 volts at the needle point. The point must be inserted in a slanting direction in the hair follicle to a depth of $\frac{1}{10}$ in.; then the circuit should be closed by a small lever switch on the handle of the instrument, and current passed for about ten seconds. A slight frothing at the base of the hair will show completion of the operation, when the hair should come away freely in the tweezers. There is no danger of inoculation from the use of Leclanché cells, or, indeed, any other form of battery. But germs may be conveyed by dirty needles; hence the utmost cleanliness is necessary.

Sills for Bay Window.—In setting out the sills of a bay window and obtaining the bevel cuts, first set out A B C (Fig. 1), which shows the angle made by the side frame with the front frame, then mark off the breadth of the sill from A and C, and draw D E and E F parallel to A B and B C respectively; join B E, which is the mitre line between the ends of the sills as shown. At Fig. 2 is shown a conventional view of the end of a sill set out for pulley stile, inside lining, and outside lining. Some-



Sills for Bay Window.

times the outside lining is notched over the sill the amount of its projection in front of the pulley stile, and this is always done if the edge of the lining is moulded or rounded on its edge; in this case the shoulder line would be as shown at B. But frequently the shoulder for the outside lining is cut about ¼ in. in front of the face of the pulley stile as indicated by the dotted lines at A. The setting out of the mitre line of the sill is also shown. Fig. 3 shows the sill cut out for the pulley stile and linings, also cut to the mitre; but this is often left until after the linings, etc., are fixed on.

Vellum for Banjos.—For good hard-wearing qualities, transparent vellums for banjos are considered the best; they are more frequently met with on the old-fashioned open-back banjos. White vellums are of special manufacture, mostly for use on zither banjos fitted with metal rims and closed backs. The reflection of tone is considered to be due to these backs rather than to the quality of the skins. Another fact worth noting is that, for the sake of appearance, the skins are generally put on these high-class banjos rough side outwards, the rough side being whiter in finish. A white appearance can be imparted to the skin by wiping with water in which rice or isinglass has been boiled, and whilst still damp rubbing with whiting.

Re-covering Writing Table Top.—In re-covering a writing table top, first clean off the old leather covers and well smooth the surface with glasspaper. For roans, morocco, and leather cloths, make a paste of rye-flour and boiling water, stirring well to keep it free from lumps, and for oilcloths use hot thin glue. Cut the leather rather larger than the space to be covered, then paste the top, rubbing well in with a stiff brush and picking out lumps. Next warm the leather before a fire or stove, place it on the table top, and, commencing in the centre, with a cork pad work out the wrinkles and puckers to the ends and side. Continue stroking until the leather lies quite flat, then dress it off with a sharp, thin-bladed knife and lay down the edges. For thin leather cloth a rubber-covered squeegee is even better than the cork pad. For oilcloth the process is the same, but hot thin glue is used as the sticking medium. Start smoothing in the centre and keep the hands clean. No advantage will be gained in wetting the cloth, and if paste is used it should be as thick as starch.

Prawn Trap or Net.—In making a prawn net or trap to commence with small meshes in the centre and gradually increasing in size to the outside, it will be necessary to follow the instructions given in Series I., p. 186, and make a small square of netting (Fig. 1), using the smallest needle and mesh stick. Then tie the centre of this, as shown at A (Fig. 2), place the loop of A over

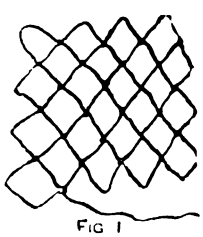


FIG. 1

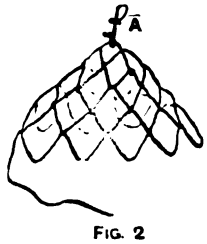


FIG. 2

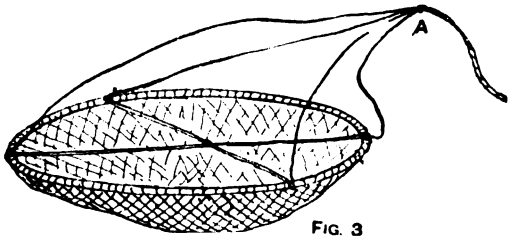


FIG. 3

Prawn Net or Trap.

the hook and work round the outside of the net, using a larger stick to increase the size of the mesh while proceeding, or until a net of the required diameter has been worked. Now procure a hoop 16 in. to 18 in. in diameter, and made of ¼-in. round iron, and secure the hoop to the net by wrapping a cord closely round the iron so as to conceal it, and looping up the outer meshes of the net at intervals. Next tie two stout cords across the net tightly to cross each other in the centre for holding the bait as shown in Fig. 3, and also two cords loosely, which are tied at their intersection A to the cord used for drawing the net.

Nitric Acid Glue.—The following is a satisfactory receipt for nitric acid glue. Put 8 oz. of best glue and ½ pt. of water into a wide mouthed bottle and dissolve on a water bath. Then add slowly, while still hot, 2½ oz. of nitric acid, stirring the while. Effervescence takes place and nitrous oxide is generated. When all is cooled, keep well corked. Afterwards add a few drops of oil of cloves to prevent mould. If too much nitric acid is used the glue does not harden.

Sharpening and Setting Razors.—The edge of a new razor properly set appears as in Fig. 1, the angle being acute, and, for a considerable time, if no accidents occur, stropping every time it is used will be sufficient to keep it in order. After a time, as the cutting edge wears away, the angle becomes more obtuse, as shown by Fig. 2, and the leather of the strop will not remove sufficient metal to work the edge to the proper angle. It is therefore necessary to use an oilstone, or if in bad condition or badly notched, a grindstone first and then the oilstone. A Turkey stone is the best to use for the purpose, as it cuts quickly and leaves a good edge, but if one of these is not available a Washita or some other coarse cutting stone may be used first, and the edge finished on a hard stone such as a Charnley Forest. The use of the stone is to remove the black portion at A (Fig. 2), and to do this the blade is placed on the stone with the back and edge resting on it as shown in Fig. 3, and rubbed up and down lengthways of the stone, both sides of the blade being rubbed alternately until the waste metal A (Fig. 2) is removed. The sharpening on the oilstone should be discontinued just before the cutting edge is reached, unless the edge is notched, or a wire edge will be the result, that is, a thin edge of metal that will bend backwards and forwards when the blade is turned over will be formed. The oilstone should be thoroughly clean, and lard or sweet oil mixed with about a quarter of its bulk of petroleum should be used. The razor is now ready for stropping, and a strap of buff leather, such as an old army belt, is one of the best tools that can be used for this purpose. As a substitute, a piece of fairly hard leather may be glued on to one side of a piece of wood, the surface of the leather being dressed with a little rottenstone and oil, and a piece of soft buff leather may be mounted on the other side of the wood; the dressed surface is used first. In using the strop the blade should be drawn along the leather back first as shown by the arrows A (Fig. 4), then turned over with the back of the blade on the strop as at B (Fig. 4) and not edge downwards, for the return

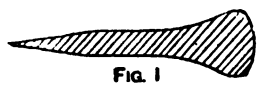


FIG. 1

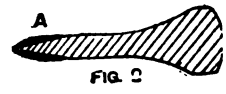


FIG. 2

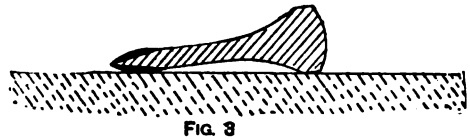


FIG. 3

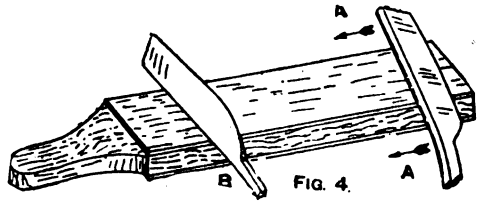


FIG. 4

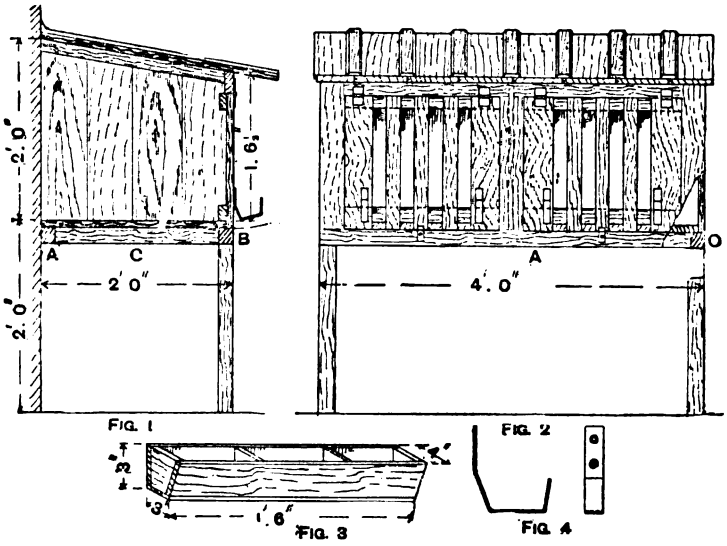
Sharpening and Setting Razors.

stroke. A few rubs should be sufficient on the soft leather only, the dressed side being used when the razor is in bad condition. Two or three razors should be in use at a time, as it is often found that if given a rest for a week or two a blade that has apparently got out of order will then work better than ever. The strop should be used after shaving as well as before, so as to put the razor away in a good condition.

Gilding French-polished Surface.—On French-polished or shellac-varnished surfaces spirit size is not used successfully, as the spirit destroys the foundation by acting as a solvent of the gums. First make up a size of isinglass (as much as will lie on a shilling) dissolved in a tablespoonful of warm water, and carefully strain this solution through a piece of fine silk. With this size line out the portions to be gilded, using a fitch or camel-hair pencil, and whilst the size is still wet apply the gold leaf with a tip or by any other method. Faults in the gold leaf, or broken joints, should be coated with fresh size and covered with more leaf. Allow the work fully twelve hours to dry. If the work is to be double gilded, the operation already described should be repeated, the size being floated freely over the gilded surface. When thoroughly dry the gilding is ready for burnishing. The burnishing is done by rubbing the gilded parts with a burnisher of agate or of polished steel, of a shape and size suitable for the work. The rubbing should be done with light straight strokes in one direction only, and must on no account approach a scrubbing motion; experience alone will tell the operator when to leave off. No lubricant is applied either to the gilding or to the burnisher. The brilliancy of burnished gilt work depends to a large extent on the smoothness and the polish of the surface to be gilded.

French Polish for Marquetry or Inlaid Woods.—For marquetry work, bleached, commonly called white, shellac is used. It is sold in the form of whitish grey twisted sticks, and at the stores should be kept under water. Crush ¼ lb. into small fragments, and spread out on clean paper in a warm room; frequently turn it over till it feels quite dry; then place it in a jar or glass bottle, adding 1 pt. of best-quality methylated spirit. Set the solution aside in a warm place, frequently agitating till dissolved, strain into another clean bottle, and thin out by adding ¼ pt. of spirit if the solution is too thick. This polish is used by the majority of polishers; a higher grade polish may be made by dissolving together 4 oz. of bleached shellac, 1 oz. of gum sandarach, ½ oz. of gum mastic, and 1 pt. of spirit. Transparent polish is sold at most chemists' and paint stores; it is made by filtering either of the above solutions through animal charcoal—a tedious process if handled in small quantities.

Fattening Pen for Chickens.—Fig. 1 shows a section and Fig. 2 a front elevation of a pen or coop for use in fattening chickens or keeping broody hens. The pen is made of ¾-in. matchboarding, and will hold two fowls. The legs and framing may be of 1½-in. by 2-in. deal, and the doors are hinged at the top and



Fattening Pen for Chickens.

secured at the bottom by means of turn-buttons (see Fig. 2). The doors lift for cleaning, but some pens are made with a barred bottom, and have a drawer underneath to catch the excrement. The roof is of ¾-in. matchboarding, and strips are nailed over the joints to keep them weather-proof. A piece of zinc may be fixed to the wall at the back to prevent the water running down behind, and the roof projects about 6 in. in the front to keep the feeding troughs (Fig. 3) dry. The compartments, or at least the one to hold water, should be lined with zinc. The troughs are held in position on the doors by brackets made by 1-in. by ¼-in. hoop-iron bent to fit (see Fig. 4). In making the pen, the front and back rails A and B (Figs. 1 and 2) would first be framed together with the legs and the end rails C. The last would then be nailed to the wall and the bottom fixed. The front and ends could then be framed and nailed in position, and a partition added to divide the two pens. Next the roof would be put on, and the doors framed together by simply nailing the ledges across the uprights, and then hung in position, iron hinges screwed on the face being used.

Making Ginger Beer.—Recipes for home-made ginger beer are given in Series I., p. 338, and the following deals with the making of ginger beer in large quantities for sale. Ginger beer may be made from ginger syrup and water charged with carbonic acid gas. First a ginger essence is made by treating 1 lb. of the best ground ginger with ¼ pt. of spirit of wine and filtering; the residue is treated with a further ¼ pt. of spirit, which is also filtered and added to the original. A syrup is now made from white sugar 2½ lb. and water (hot) 1 pt.; when this is cold sufficient of the essence of ginger is added to it to produce a decidedly hot flavour; a portion of the ginger syrup is then put into each bottle, which is filled up with aërated water from a machine. For stone bottles the ginger beer is very often fermented; a sugar solution is made and boiled with a little coarse ginger, strained and then fermented overnight, and, after straining off the yeast, it is bottled; the after fermentation in the bottle produces the aeration required.

Apparatus for Tuning Concertinas.—Whether it would pay to make a special apparatus for tuning concertina reeds in thirds, fifths, and octaves depends on how many reeds have to be tuned. A practical man could tell very nearly if the reeds are correct by slightly plucking them with the finger nail or a piece of brass filed like the blade of a small pocket knife. In testing a reed, it is not necessary to screw on the head of the instrument each time. The workman, seated, grips the instrument, fixed end downwards, between his knees. The reed plate being inserted, instead of turning the screws in, the loose end is put in position and firmly gripped together with the top rim of the bellows. A few moments only are required to show whether the reed is in tune or not. A simple apparatus for tuning reeds singly may be made out of an old but sound concertina. Remove one end, and replace by a thin piece of board larger than the instrument. In this cut two holes with a simple valve to each; over the holes must be placed a spring slide arrangement, adaptable for the varying sizes of reed plates; this will enable two reeds to be sounded together. Such apparatus being a fixture, it is impossible to exert the same degree of wind pressure on the reeds as when in the instrument; it may be found that some slight alteration of the reeds will be required when they are in their right places.

Removing Broken Screw from Watch Plate.—Tools are sold for the purpose of removing broken screws from watch plates, but they seem to be of little or no use. If the screw projects a little, slit it with a slitting file and screw it out. If it is not very tight and is broken low down in the hole, try two sharp graver points on opposite sides, held one in each hand, to turn it out. If the screw is tight and not hard, drill it right through and broach it out. If hard, make a hard punch to fit the hole and have a flat end to rest on the screw. Rest the plate on a steel stake over a hole and, with a heavy and sharp blow with a hammer, punch the screw right out. This will strip the thread from the hole and necessitate re-tapping.

Leather for Pumps.—Oil-dressed leather about ⅛ in. thick is the best kind to use in pumps, and the flesh side of the leather should rest upon the brass flanges of the pump. The best part of the hide is the back portion, and the worst parts are the belly and limbs. Cups or buckets are shaped by pressing the leather into specially made moulds.

Simple Jar-suspender.—A five-, six-, or eight-gal. jar, when full, is not very easily handled, and should be supported in a suspender when emptying or filling. For the framework or stand (Fig. 1) of the suspender procure some 2-in. square spruce or yellow pine, dry and free from knots and shakes; some 1-in. by ⅞-in. or ¾-in. flat iron for the tilter; some ⅜-in. round iron for the stays; and two pieces of ½-in. round iron 3 in. long for pivots. Of the wood, cut two pieces 2 ft. long for the runners A, two cross pieces B, 1 ft. 7½ in. long, and two uprights C, 1 ft. 4 in. long. Tenon and mortise the uprights into the runners at the centre, and half-check the cross pieces into the runners, leaving about 2½ in. of the runner projecting, the end being chamfered. Cut four pieces of round iron for the stays, heat the ends and form palms on them, the stay itself making an angle of 30° with the upright. A hole is drilled or punched in each palm and countersunk, and the stays are secured in place with long screws. If the countersink be omitted, a round-headed screw can be used. The suspender or cage (Fig. 2) may next be constructed. For the main piece a length of 3 ft. 1 in. of the flat iron will be required, and may be bent twice at right angles, the bottom measuring 1 ft. 1 in. across.

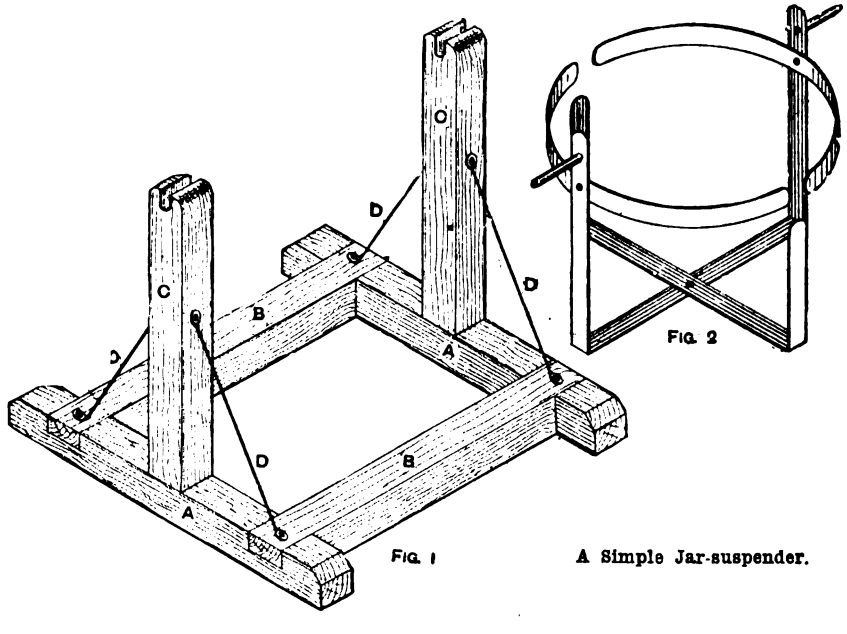


FIG. 1 A Simple Jar-suspender.

FIG. 2

A ⅞-in. or ⅜-in. hole may be drilled in each arm about 1½ in. from the top, and the ½-in. iron 3 in. long, with a shoulder worked to fit, may now be riveted into the same. Another 2 ft. 3 in. length of flat iron is similarly bent to measure 1 ft. 1 in. at the bottom, and a ½-in. hole is bored in the centre of this and in the main piece, these being riveted together at right angles. Two pieces 1 ft. 5 in. long are bent to a circular form and riveted to the main arms about 3 in. from the top. In the slots cut in the uprights, on light bushings of brass or iron, fit the pivots on the main piece of the suspender. The jar is then placed in the cage, and can be emptied from either side of the stand. Of course a larger jar will require a larger suspender, but the sizes given here are for a 5-gal. jar.

Restoring Faded Photographs.—Restorations of yellow and faded photographs (silver prints) to their original colour are seldom or never attempted, for if the picture is sufficiently valuable to make restoration desirable, the risk of destroying the photograph is generally considered to be too great. Perhaps the best plan is to make a new negative by copying the print through pale blue glass. The blue glass will destroy the yellow rays and make the picture brighter and more distinct. The following treatment has, however, been recommended for faded prints. Make up two baths, (A) tungstate of soda ½ oz., water 25 oz.; (B) carbonate of lime 9 gr., chloride of lime 2½ gr., chloride of gold and sodium 9 gr., distilled water 2 oz. The B solution should be made in a yellow stoppered bottle, allowed to stand for twenty-four hours, and filtered. For one cabinet print take 2 oz. of A and 40 minims of B. After immersion for about ten minutes, or when the image has assumed a purple colour, well wash the print and immerse it in a clearing bath of 2½ oz. of A and 2 dr. of hyposulphite of soda until the yellow colour has disappeared (for this probably some hours will be required). A simpler plan is to immerse the print in a weak solution of mercuric chloride, and follow by the application of a solution of hyposulphite of soda 2 gr. per oz. If the print is mounted it must be removed from the card.

Cleaning and Renovating Shop Fittings.—A clean finish on shop and office fittings will give far more satisfaction than laying on a heavy body of polish or varnish on a surface imperfectly cleansed. Wash down with warm soda water—a cupful of common washing soda dissolved in 1 gal. of water; use a brush to get it well into quirks and corners, and swill off with clean water. Should the dirt still linger after a second washing, touch up the worst places with a bleach made by dissolving 1 oz. of oxalic acid in 1 pt. of water. As the dirt is removed, swill off again and brush over with common malt vinegar all parts touched by the acid. Neglect of this latter precaution will cause any stain that may have been used to soon fly, thus giving the work a patchy appearance. On surfaces thus cleansed, a smart bright appearance may be imparted by a smart rubber of polish and glaze, or the application of spirit varnish carefully laid on with a camel-hair brush. A slight tinge of red is imparted to the varnish used on pine or walnut finish goods, and the mouldings are picked out with varnish more heavily stained.

Tests for Distilled Water.—Nitrate of silver solution is used in one method of testing distilled water. This nitrate ($AgNO_3$) is a silver salt, and is obtained by dissolving pure silver in nitric acid and evaporating the solution; the salt then separates out in crystals. The strength of the silver nitrate solution depends on the amount of water taken for the analysis. The cloud produced in water by silver nitrate shows the presence of a chloride, probably common salt; this reacts with silver nitrate, forming insoluble silver chloride. A precipitate would be formed with a carbonate or phosphate if present in large amount, but in ordinary waters only the chlorides produce a precipitate. A red precipitate is insoluble silver chromate. The estimation of the salt depends on the fact that the chlorine has a greater affinity for silver than for the chromate; hence no chromate is formed until all the chloride is used up. Add silver nitrate until the first trace of chromate is precipitated; then measure the amount of silver nitrate solution used to obtain a measure of the amount of chloride present. The strength of the silver nitrate is so adjusted that one measure of it required by the volume of water taken equals 1 gr. of salt (or chlorine) in 1 gal. of water; this adjustment is easy. The weights now used are generally avoirdupois, 437½ gr. to the ounce.

Removing Brass Collars from Glass Ware.—As a rule, the collars, etc., of oil lamps and similar glass ware are fastened with plaster-of-Paris. To remove the collar, place it in a vice to the jaws of which two pieces of thin sheet lead have been fitted, then with both hands take hold of the glass vessel and carefully rotate it. If the collar cannot be removed by this treatment, the vessel should be soaked for some time in water, and again submitted to the process. (See also Series I., p. 119.)

Music Cabinet.—Accompanying this are the necessary working drawings, fully dimensioned, of a music cabinet that can be constructed of walnut. Fig. 1 is a vertical section of the cabinet; Fig. 2 is a cross section; Fig. 3 is a horizontal section; Fig. 4 is an enlarged plan of the corner of the bottom; Fig. 5 is a detail of D (Fig. 1); Fig. 6 shows the method of hingeing the drawer fronts; whilst Figs. 7 and 8 show an elevation and section of the top of the cupboard. From the drawings it may be seen that the standard size of portfolio music (14 in. by 10 in.) is taken as a basis for the construction. Set out the plan, full size, as shown in Fig. 3, the inside dimension of the drawer being 1 ft. 4¼ in. by 10¼ in., the drawer sides ¼ in., and the case sides and division ¾ in. thick. The cupboard is 8¼ in. in the clear, the outside size 2 ft. 2 in., and the depth 1 ft. 0⅛ in. The height over all is 3 ft., the plinth being 6 in. high, and the moulded top made up to 2 in. thick. Having set out the heights of the plinth and top, mark the bottom so that its lower edge is covered ¼ in. by the plinth, and the rail B, Fig. 2, ⅞ in. thick, ¼ in. under the moulding at the top. Then divide the intervening space into six equal parts for the drawer divisions, which are ¾ in. thick, all framed and panelled with the exception of the one under the cupboard, which must be solid. All the divisions are grooved in ½ in., the rail B being stub-tenoned as shown in Fig. 5. The top is made of ¾-in. board, overhanging the carcase 1 in., and either blocked or buttoned thereto, as shown in Fig. 5. The moulded edging is mitred and glued in the rebate formed by the top and sides. The shaped rail A (Figs. 1 and 7) is grooved and glued into the standards. The sides run 2 in. below the plinth and rest on 1½-in. blocks C (Fig. 2) glued in the angles of the plinth, which may be fitted with castors if desired; the back is a ¾-in. panelled frame. The drawers, if fitted with tilting fronts, would be made as shown in Fig. 6, the backs being dovetailed to the sides, and the bottom grooved in as usual, with the exception of the front edge. Before setting out the drawers the bracket pivots should be obtained, as they vary in length. To find how much to bevel the drawer sides, screw a pivot on so that the flange is flush with the end of the side and at such a height that it will easily drop clear of the bottom. Then revolve the bracket, and with a pencil mark the path of the upper end, as shown by the dotted line in Fig. 6; draw a chord line on the arc from where it cuts the end and bottom edge, and cut the side off to this line, when the front will work clear. The brackets may be sunk flush into the sides and front. If it is desired to make the front fit close instead of with a gap, as shown, shape the sides to the curved dotted line (Fig. 6) and make a corresponding piece to the hollow curve and glue it to the front and also a narrow slip to complete the bottom.

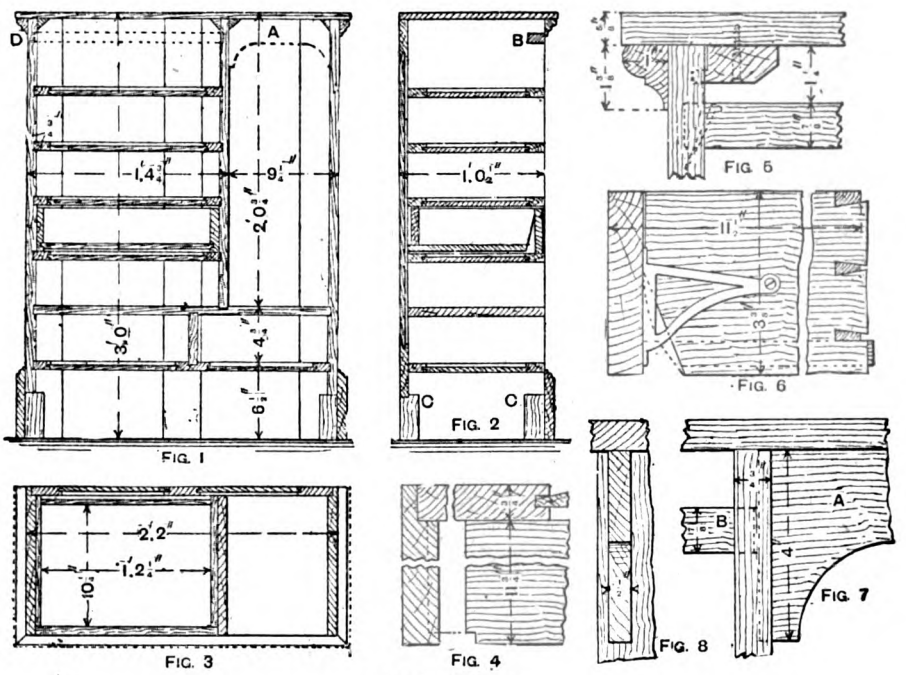


FIG. 1 FIG. 2 FIG. 3 FIG. 4 FIG. 5 FIG. 6 FIG. 7 FIG. 8

Music Cabinet.

Making Metal Spoons.—A mould for making imitation silver spoons may be a fine cast-iron casting. Much labour, however, will have to be expended on the cast spoons in order to make them presentable, owing to the natural roughness of the cast article. The better plan would be to buy the blanks ready cut out; a hand stamp, with drop-hammer tools to form the bowl and handle, also a polishing spindle and emery wheel, would be needed. The quality of the metal for making the articles will depend on the taste of the maker; the articles can be either a pale yellow or a colour very nearly approaching silver itself. The following may be taken as good quality white metal alloys. Copper, 5 lb.; zinc, 25 lb.; and nickel, 25 lb. Copper, 5 lb.; zinc, 27 lb.; and nickel, 19 lb. Copper, 60 lb.; zinc, 20 lb.; and nickel, 20 lb. The last will give a faintly yellow colour. The addition of a small quantity of iron will increase the whiteness, since 1 per cent. of iron is equal to about 3 to 4 per cent. of nickel. The iron, however, should not exceed 3 per cent. For cast goods, a small quantity up to 2 per cent. of lead may be added to the alloy; this will considerably whiten it. It must, however, be well mixed when pouring, or the lead will have a tendency to liquate out and cause blotchy specks on the surface of the casting.

Snow Tree.—Below are hints on making a snow tree in a bottle. Cut off the bottom of the bottle and apply two or three coats of varnish to a small branch of a tree having a number of short twigs, the whole of which will go into the bottle. Apply varnish also to the cut end to prevent water entering. When the last coat of varnish is partly dried and tacky, "frosting" (fine flake glass) may be dusted all over it; this will produce the appearance of hoar frost. The tree may then be placed in the bottle, and the bottom cemented in place with Canada balsam.

Removing Scale from Cast-iron.—To remove scale from cast-iron, immerse it in slightly diluted sulphuric acid, heated to about 90° F., for about ten minutes, then pickle in hydrochloric acid for twenty-four hours. If there are any black spots then still showing on the surface of the metal, they should be scoured off with sand and water, applied with a hard brush. A further immersion in the raw spirit, and then a second scouring with the brush in clean water, will leave the surface grey and clean.

Finding the Centre of a Circle.—The following are established truths. (1) Any solution to a geometrical problem that involves the oblique intersection of lines tends to inaccuracy, the tendency increasing with the obliquity. (2) Any two points through which a straight line has to be drawn should be as far apart as possible. (3) It is an advantage to reduce the number of lines in any problem to a minimum. With these points in view is submitted the following method of discovering

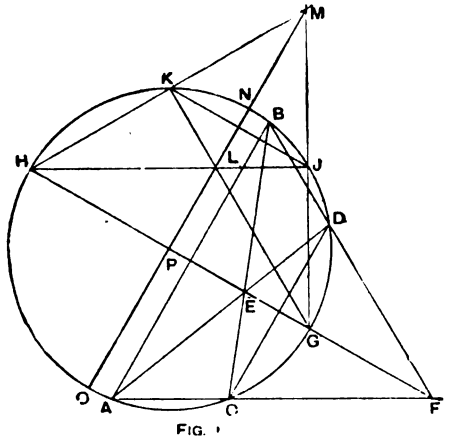
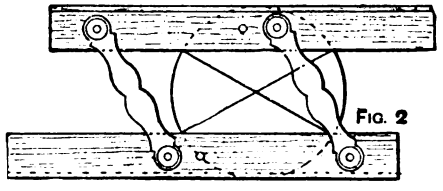


FIG. 1



Finding the Centre of a Circle.

the centre of a circle with only a pencil and parallel ruler—an ordinary ruler will answer if it is accurate and not too narrow. First draw the two parallel chords A B and C D (see Fig. 1); then through their extremities draw the two pairs of lines which intersect in E and F respectively. A line through E and F gives a diameter G H, and therefore contains the centre. When drawing this line, draw also the chord J K parallel to it; and then proceed as before to obtain the line L M, which gives another diameter N O. The intersection P of the two diameters is the required centre. Of course, two fresh chords might be taken to obtain the second diameter, but by using the diameter H G and a parallel chord the number of lines is reduced, and all possibility of obliquity at the centre is avoided. If a linked parallel ruler is obtainable a much simpler method can be adopted. Open the ruler until the outer edges become tangential to the circle (see Fig. 2). Then with the inner edges draw two chords across the circle. These chords will be equal and parallel, and if their extremities are connected by lines as shown, the intersection point is the required centre. There are limitations to this method; if the circle is very large the extended ruler will not reach across, and if it is very small the two chords will be too close together.

Oil Varnish Failing to Dry.—Surfaces to be oil varnished may be washed with a weak solution of common washing soda or benzoline in order to kill any trace of grease. Another plan would be to wash the surface with clean water, and rub with fine-grade pumice powder; then wipe perfectly clean and dry, and if possible apply the oil varnish in warm, dry weather, or in a place that is free from excessive moisture or draughts. Neglect of these precautions, the use of a brush that is not perfectly clean or a brush that has been suspended in oil, the use of varnish that has been left uncorked or otherwise exposed to atmospheric influences for a long period, are probable causes of oil varnish not drying. The remedy would be to remove the present varnish by means of warm turpentine. Then apply another coat of varnish the drying qualities of which have been proved by previous tests to be thoroughly reliable.

Pattern for Pipe Bend in Segments.—To obtain the pattern for a pipe bend in segments, draw a side elevation and plan, as Figs. 1 and 2. Then divide the outer curve of the bend into a number of equal parts, corresponding to the number of segments required for the complete bend, and join the division points by straight lines to the centre O, from which the inner and outer curves have been drawn. Now bisect one segment by the line $a\,g$, as shown, and also divide the semi-plan of the base (Fig. 2) into a number of equal divisions, as A, B, C, etc. Draw projectors from

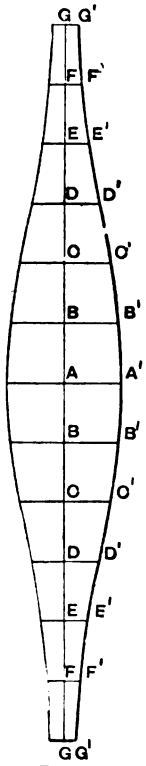
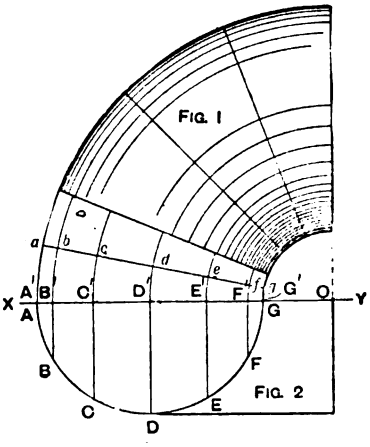


FIG. 3



Pattern for Bend in Segments.

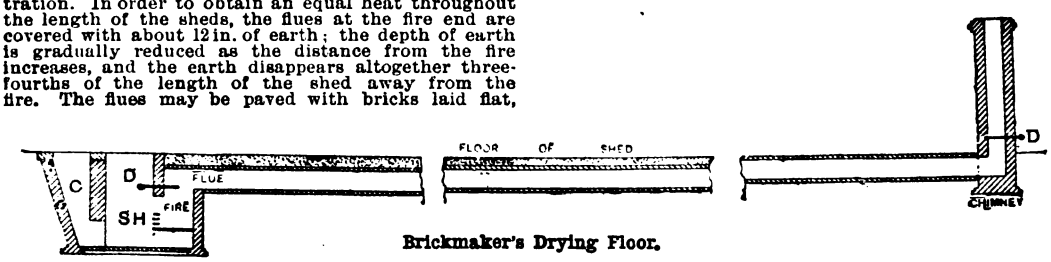
these division points to the ground line to give the points A^1, B^1, etc. With G (Fig. 1) as centre and radius to B^1, C^1, D^1, E^1, and F^1, draw the arcs of circles shown. To work the pattern Fig. 3, on a straight line set off twelve equal divisions, corresponding in size to those round the semicircle A B C, etc. (Fig. 2). Through each of these divisions, A, B, C, etc., on the pattern draw lines at right angles to and on both sides of the centre stripe G G. If the seams are to occur at the throat of the bend, take the distance $G^1 g$ from Fig. 1, and mark off on each side of the centre line on the pattern at the top and bottom ends; then take $F^1 f$ from the elevation and transfer to the next division to G on the pattern. Take the remaining divisions $E^1 e$, $D^1 d$, etc., from the elevation, and transfer these in the order shown to the pattern. A curve drawn through the points A^1, B^1, C^1, etc., on each side of the pattern would complete the figure. Allowances for lap at the seams and also along one curved side must be added in proportion as shown.

Testing Drains.—The vapour test for a drain consists in pouring into the drain 1 oz. of essence of peppermint, essence of cloves, or other similar powerful scent, followed by a can or two of boiling water. Another test consists in placing in the drain crushed brimstone or sulphur wrapped in paper saturated with petroleum and setting fire to it. But vapour and smoke tests are not reliable, and may produce a feeling of false security. The most reliable is the water test, which is carried out as follows. Plug the drain at the lower end, fill the drain with water up to some point where the water can be seen, and carefully mark the height of the water. If the water remains at the same level for several hours, the drain may be considered to be sound; if the water sinks below the level, a leak will be found in the neighbourhood of wet earth.

Green-bronzing Brass and Copper.—In green-bronzing metal articles, after removing all dirt and grease from them, if of brass, dip in a bath of 1 part of perchloride of iron dissolved in 2 parts of water. Leave the articles in the bath till they are of the required shade, then lacquer them with pale gold lacquer. To green-bronze copper goods, such as small trays, etc., steep them for a few days in a strong solution of common salt or sal-ammoniac. Well wash them in water, dry slowly, or suspend them over a vessel containing a small quantity of bleaching powder, and cover them. The depth of tone given to the articles depends on the length of time which they are in the solution.

Renovating Marone Leather of Furniture.—The surface of marone leather may be cleaned with warm water in which a piece of soda has been dissolved. Make up a varnish stain of 2 oz. of orange shellac dissolved in 1 pt. of water on a water bath, and, whilst the liquid is hot, add to it sufficient marone aniline dye to give a deep garnet colour; there are two kinds of dye, one being soluble in spirits, the other in water. If the shellac does not wholly dissolve, it must be strained. A swab of soft rags or a sponge should be used for applying the solution. When thoroughly dry, glaze the leather with a dressing composed of ½ pt. of raw linseed oil and 1 gill of good cream, adding a dash of turpentine to assist the drying. Allow the dressing to stand ten hours before using, and shake well. New banding and studs greatly improve the appearance of worn furniture.

Brickmaker's Drying Floor.—To construct a drying-shed floor capable of holding 50,000 or more bricks, arrange a series of parallel flues about 18 in. square and 200 ft. long, a fire-grate being at one end and a chimney at the other end, as shown in the accompanying illustration. In order to obtain an equal heat throughout the length of the sheds, the flues at the fire end are covered with about 12 in. of earth; the depth of earth is gradually reduced as the distance from the fire increases, and the earth disappears altogether three-fourths of the length of the shed away from the fire. The flues may be paved with bricks laid flat,



Brickmaker's Drying Floor.

and covered with tiles, flags, or iron plates. As many flues as are necessary may be constructed side by side; each flue will serve for a drying area of 3 ft. wide. For 50,000 bricks, a floor 96 ft. by 200 ft. will be required, allowing 10 in. by 5½ in. for each brick. In the illustration the letter references are C, coals or coke; SH, stokehole; DD, dampers. By another method of drying bricks a trolley loaded with bricks is drawn through a large flue by a slow-moving chain. Also there are other systems of drying bricks.

Moulding White Wax.—If it is desired to shape white wax, it should be melted and then poured into moulds of the proper size. If the sticks are to be square or rectangular in section, the wax may be moulded in large square or flat cakes in tinplate boxes cooled by placing in water. These cakes may then be put in a warm place (not too warm or they will melt), and cut up into sticks by means of a thin steel wire set on a frame; the blocks of wax may first be cut by it into thin cakes, and these again subdivided into sticks. Waxes are coloured with the coal-tar dyes, known as colours soluble in oil. To harden white wax, add to it resin or carnauba wax.

Smoke-producing Material.—For a material that will burn slowly, give off plenty of smoke, and that will not be unpleasant, mix together with a little water 1 lb. of powdered wood charcoal, ¼ lb. of gum benzoin, and 1½ oz. of nitre, then thoroughly dry it. Place a thin layer of the mixture on a saucer, ignite it with a taper or hot iron, and sprinkle upon it finely powdered ammonium chloride. This will give off plenty of smoke.

Carmine.—In the manufacture of commercial carmine success depends on the quality of the materials used; they should be the finest that can be procured. To produce a carmine of a deep scarlet tint, boil in a copper vessel with 2½ gal. of pure spring water for seventeen minutes, 3½ lb. of powdered cochineal and 1½ oz. of carbonate of potash; remove the vessel from the fire, cool down to 100°, and add 3 oz. of powdered alum and 1 dram of cream of tartar. Agitate the mixture for several minutes with a bone spatula, and allow to settle for twenty minutes; the clear liquor is then taken off by means of a syphon and placed in a perfectly clean copper vessel. Now add 1½ oz. of pure isinglass dissolved in ¼ gal. of water; again place the mixture on the fire, and agitate with the bone spatula for ten minutes; then take it off and allow to stand for two or three days, when the carmine will all be settled. It is then collected and dried previous to being ground into paint. Carmine generally put up in collapsible tubes is not absolutely pure; it usually contains several adulterants, such as vermilion, Derby red, orange chrome, and the aniline lakes and chrome reds. The following is a recipe of one of the principal manufacturers:—carmine 3 lb., deep orange chrome ½ lb., vermilion ½ lb., terra alba 7 lb., refined poppy oil 3 pt. Pure carmine is exceedingly light, and is not a permanent pigment; it is soluble in ammonia—a test by which its purity is determined, as the insoluble impurities are left.

Ammonia Soft Soap.—For a white ammonia soft soap, melt down ordinary soft soap with the least possible heat, and to each pound add 1 oz. of ammonia, then allow to cool. The soap pan should have a hood over it to carry away the fumes. The operation will be found rather trying.

The Use of Dye Woods in Spirit Varnish.—Vegetable dye-wood extracts and aniline dyes are both liable to fade somewhat if long exposed to the influence of strong sunlight. The risk is lessened very much if the articles coloured by their use are afterwards protected by a film of clear varnish or polish. Thus, if bismarck brown, which is an aniline dye, is used for imparting a mahogany colour and the coloured varnish or polish is used throughout, the colouring will be sure to fade in strong sunlight. On the other hand, if when the desired tone is gained the work is finished with clear polish or varnish, it will retain its colour for a much longer period. The same principle, it should be said, applies to the use of dye woods, which are now generally looked upon as old-fashioned, owing to the trouble in gaining the desired colour from them as compared with the simplicity of aniline salts. Dye woods, however, give the best results as regards permanency, especially if protected as advised.

Cleaning White Leather Breeches.—White leather breeches are rather difficult to clean. Try a mixture of benzoline and light magnesia; the magnesia can afterwards be brushed out. In cleaning leather, the only drawback to the use of benzoline is the fact that it dissolves the oil out of the leather and renders it dry. To remedy this, the leather should be worked about with the hands and a very little oil rubbed in at the back. If the leather is whitened by a superficial coating, it would not be necessary to clean it in this way; it should be cleaned with breeches paste, a preparation made by certain blacking makers.

Bending Edges of Brass Door-plates.—One way of bending the edges of brass door-plates and nosings is to screw a length of angle iron along the top edge of the bench; on this place the metal, with the part to be folded overhanging the edge of the angle iron, and work it down square on the iron with a dresser. Then work down to the fold desired on a hatchet stake. When the brass is to be folded to a sharp angle, with any sharp tool cut it along on the inside to a slight depth, and then set it down as described above. A better method than either of the above would be to bend the brass in an angle-bending machine, which is supplied with suitable fittings that allow the fold to be either sharp or rounding as desired.

Hard-soldering Eyelets on Metal Buttons.—Hard-soldering eyelets on metal buttons, badges, etc., is accomplished by means of the gas-soldering apparatus, by which air and gas are mixed in a double tube and the pressure given by the action of a double bellows, the material to be operated upon being partly embedded in a pan containing small coke.

Heat-resisting Cement for Stone.—A cement for stone that has heat-resisting properties may be made by mixing together the following ingredients (all in a fine powder), and just before use wetting them to proper consistency with water. Clay, 10 parts; iron filings, 4 parts; peroxide of manganese, 2 parts; common salt (chloride of sodium), 1 part; and borax, 1 part. For another stone cement that will withstand a high temperature make 1 part of sulphate of barium and 2 parts of clay into a paste by adding a solution of silicate of potash and borax.

Folding Rack for Drying Photographic Plates.—A simple rack for drying photographic plates is shown by Figs. 1 to 4. To make it the material required is as follows. Four pieces of wood A, 7 in. by 1 in. by about ¾ in., and two pieces B, 8 in. by 2 in. by about ¾ in., and a few fine nails. Having cut and planed the wood, bore holes in the centres of the pieces A, and fasten them together in pairs with nails N. Next rule a line on the pieces A ½ in. above the centre of the nails to obtain the position of the pieces B, which are marked out as follows. On the same side and 1½ in. from each end make marks and divide the space between these into ¾-in. lengths; next make marks $\frac{1}{16}$ in. on each side of these lengths, and rule these right across with a square. Then make saw kerfs on these lines about ¼ in. deep and remove the ¾-in. pieces of wood with a chisel, thus

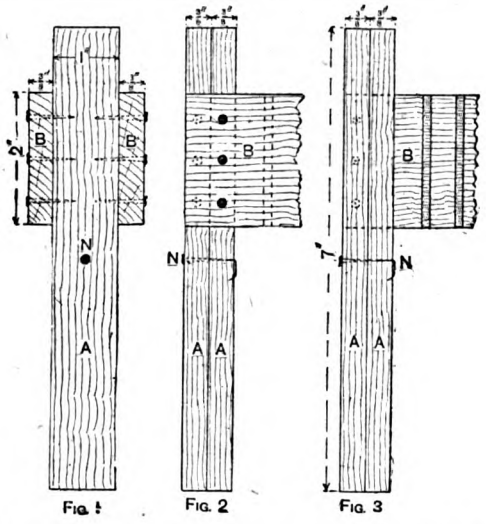
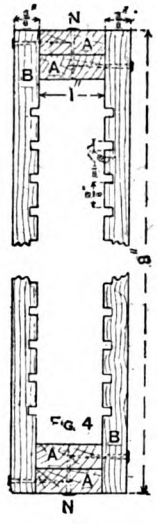
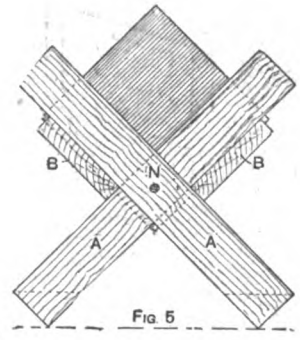


Fig. 1 Fig. 2 Fig. 3





Folding Rack for Drying Photographic Plates.

making the slots for holding the plates. Each of the side pieces B is nailed to the end pieces A as shown in Fig. 4, care being taken not to nail both sides B to the same pieces A. Fig. 1 shows an end view of the rack when closed; Fig. 2 a part side view (closed); Fig. 3 a part side view with the nearer side removed; Fig. 4 a plan; and Fig. 5 the rack with plates in position.

Celluloid Collars.—Celluloid, known also as xylonite, is manufactured from collodion cotton, the process being to moisten it with camphorated spirit or acetone, and knead into it a pigment such as chalk, magnesite, or zinc oxide, to render the whole white and opaque. The celluloid is then rolled out into very thin sheets, and two sheets are rolled together with a woven linen or cotton basis. When the celluloid has become moderately hard it is stamped to produce the woven appearance and the collar is cut out with a die.

Cementing Yacht's Bilge.—Before cementing the floor of a composite-built yacht, it is necessary that all metal and woodwork should be scraped quite clean and every vestige of rust removed. Two coats of cement wash (pure cement) should be then applied to all steelwork; the woodwork should be given a solution of coal-tar and torch oil, and afterwards dusted with dry cement. This is carried as high up the bilge as the design of the yacht will permit.

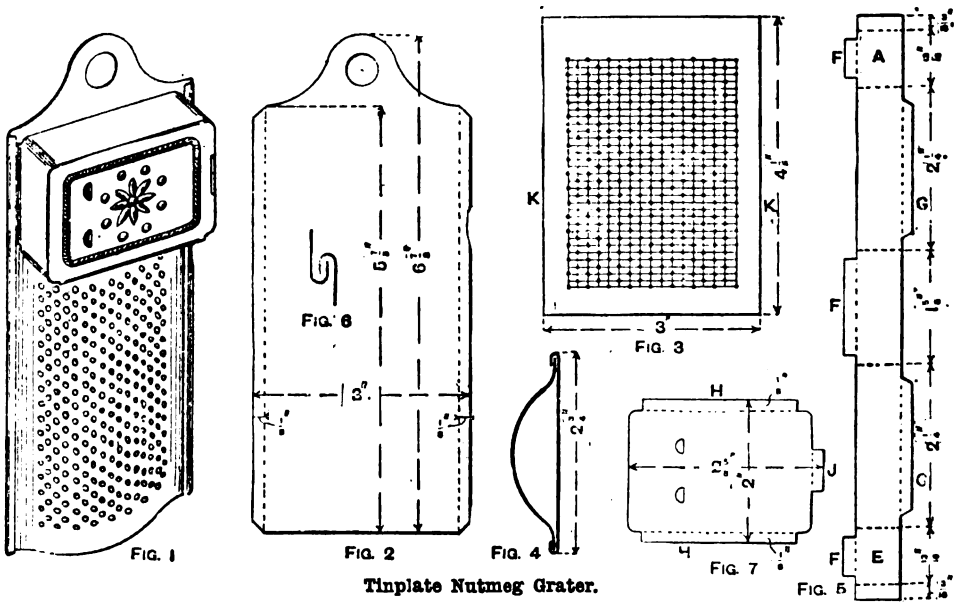
Water Stains for Wood.—The following are recipes for water stains in imitation of mahogany and walnut. A light brown mahogany colour may be obtained by a decoction of madder and fustic in the proportion of ¼ lb. of madder and ¼ lb. of fustic to each gallon of water. For a dark mahogany colour omit the fustic as above, and substitute 2 oz. of logwood extract. Brush over the wood several times, and, when dry, brush over with water in which pearlash (1 oz. to 1 qt.) has been dissolved. For a bright red stain, make a strong infusion of Brazil chips in pearlash water (1 oz. of ash to 1 gal. of water) and apply, boiling hot, to the wood; several coats may be required. While the wood is still wet, brush over again with alum water (2 oz. of alum to 1 qt. of water). An easily made stain is obtained by dissolving 1 oz. bismarck brown in 1 qt. of common malt vinegar. For walnut stain (1) mix vandyke brown in liquid ammonia till thoroughly incorporated, then thin out to the tone desired by adding soft water. (2) Boil a handful of common washing soda in 1 pt. of rainwater; mix with it drybrown umber or vandyke brown till two applications to the wood gives the desired tone. (3) Get a pennyworth of nut galls, ¼ lb. American potash, one pennyworth vandyke brown, 1 gal. water. Crush the nut galls and mix the potash, adding a small quantity of boiling water, then add the vandyke, and thin out by adding boiling water up to 1 gal. All water stains give best results if applied hot.

Ladder Making.—A ladder 35 ft. long should be made from a good straight pole cut in halves. Whether the rounds or rungs are tapered at the ends or slightly shouldered, the holes on the inside of the ladder being cut to correspond, is a matter of taste. One way is as good as the other if reasonable care is used; but if the tapered rounds are driven in too tightly, they are liable to split the pole, which the shouldered ends will not do. This is the only practical difference between the two styles. For a ladder of the length stated, namely 35 ft., the first twelve rounds should be inserted in holes ¾ in. in diameter, the remainder of the holes being ⅝ in. and ½ in. in equal numbers; this is for tapered rounds. If the rounds are shouldered, the holes can, with advantage, be bored in four different sizes, 1 in., ⅞ in., ¾ in. and ⅝ in. in about equal numbers. The diameter of the pole should to some extent be considered in relation to the size of the holes for the rounds, for if the pole is very slight, the large holes may be a serious source of weakness. Rounds should always be pinned in, not wedged, as the wedges work out.

Wax Cylinders for Phonograph.—A mould for wax cylinders for use on phonographs is best in brass, but plaster-of-Paris, or wood well oiled, can be used. The mould should be made in halves to fit together with dowels of wood; a core would also be required. The mould should be larger than the cylinders. These are roughly moulded and afterwards carefully turned down to proper dimensions in a lathe with special tools.

Cyclist's Home Trainer.—A cyclist's home trainer for practice in pedalling may be made as follows. A step is fitted to each end of the back axle of a cycle, and screwed to the floor are two standards in each of which is a slot. In these slots the steps rest, thus bringing the hind wheel clear of the ground. The front wheel may be raised to a similar height on an inverted box, and can be prevented from twisting by two wood battens.

Tinplate Nutmeg Grater.—Fig. 1 is a general view of a tinplate nutmeg grater which is very useful in the kitchen; it is 6¾ in. long by 2¾ in. wide. Fig. 2 is the pattern for the back. The dotted line at the side shows the part to be turned over when fitting together. Fig. 3 is a pattern for the grater, which can be made by cutting a piece of tin 3 in. wide by 4⅛ in. long, and marking two lines ⅜ in. from the sides, and two lines ⅜ in. from top and bottom. Then divide the horizontal lines into sixteen parts, and the vertical lines into thirty-two parts, and join. These will give the centre of holes as indicated. In punching the holes the tin should be laid on a piece of lead or soft wood, so that the burrs of the holes appear on the reverse side. It should then be bent to the shape shown by Fig. 4. The pattern for the nutmeg box should next be prepared, as shown by Fig. 5. The parts are folded on the dotted lines, so that E meets A, the parts overlapping being for the join; see Fig. 6. The parts F should be bent so as to be covered by the top of the projecting pieces in Fig. 2, and the parts G should be bent upward so as to form a slide for the door, Fig. 7 This is 2¾ in. long and 2¼ in. wide, and the parts H overlapping are bent downwards so as to slide on the parts G (Fig. 5); the piece J is bent into a small cylinder to form a handle. Two pieces are knocked down, so that the burr on the inside prevents the door sliding off. The ornamental work in Fig. 1 is produced by punching from the inside. In fitting together the parts, Figs. 3 and 5, bent to shape, are put in the piece Fig. 2, so that the edges K of the grater (Fig. 3) and the parts F (Fig. 5) almost touch the dotted lines in Fig. 2. The projecting parts are then bent over and hammered tight. The lid slides on by means of the pieces G and H (Figs. 5 and 7).



Tinplate Nutmeg Grater.

Diameter of Pelton Wheel.—The diameter of a Pelton water wheel can be made to suit the machine which it has to run: if high speed and the machine is to be coupled direct to the motor the wheel must be small. The rule for finding the diameter for a given number of revolutions and velocity of water per minute is as follows. Divide the velocity of water in inches by 2 and then divide the product by the number of revolutions, which will equal the circumference of the wheel where the water from the jet strikes the wheel. The diameter can now be found by dividing the circumference by 3·1416.

Printing-out Platinum Paper.—Below are given instructions on preparing platinum printing-out paper, but it would certainly not pay amateurs to make this paper. Any platinum paper may be printed out, but the colour of the image obtained with paper prepared in the ordinary way is rather unsatisfactory; nor are the gradations good. What is known as the Pizzighelli process, named after its inventor, Capt. Pizzighelli, is generally used for printing out. It should, however, be understood that print-out platinum images are never equal to those produced in the more usual manner, that is, by development. The printing-out process is a particularly easy one to work during the winter months, as it is essential that the paper should be kept damp, whilst the chief difficulty with ordinary platinum paper in winter is to keep it dry. The negatives for the process should be fairly dense or with particularly clear shadows. Any good quality paper free from metallic impurities may be used, Whatman's smooth surface being especially suitable. Size the paper with a solution of arrowroot, 10 gr. to the ounce. Now make up the following solutions, which should be kept in the dark. (A) Chloro-platinite of potassium, 150 gr.; distilled water, 2 oz. (B) Ammonio ferric oxalate, 600 gr.; 5-per-cent. solution of potassium oxalate, 3½ oz.; glycerine, 1 dram. (C) B solution, 3½ oz.; 5-per-cent. solution of potassium chlorate, ½ oz. In making solution B, the potassium oxalate should be warmed, and the ferric salt added. Take for each sheet of paper 84 minims of A, 100 minims of B, and 34 minims of C, and rub gently, but well, into the pores of the paper with a soft tuft of cotton-wool. In damp weather the glycerine may be omitted. The image is printed out to the required depth only, as there is no loss in fixing, which is effected by immersion in the usual baths of hydrochloric acid, 1 in 60.

Fixing Brass Plates on Writing Desks.—In fixing brass plates or mounts on writing desks secure or hold the plate in position by pressure, and then mark around it with a fine marking awl. Cut out the veneer or chop it from the solid to the desired depth. Melt a little shellac in the aperture, put the plate in position, and press it well down with a hot iron. Fish glue is also useful for the purpose.

Padouk Wood.—Padouk is a handsome red wood procured from Burma and from the Andaman Islands in the Indian Ocean. It is sold in boards, planks, and logs, up to 36 in. wide, and is suitable for furniture making, for veneers, handrails, shipbuilding, and railway carriage work. As a rule, the wood emits a peculiar earthy or humid odour while it is being planed, sawn, or turned. The price is more variable than that of mahogany, but on the average it is about the same.

Repairing Clock Escapements.—An injured 'scape wheel of a clock should first be put in the turns, or in a lathe, between centres, and revolved rapidly against a piece of oilstone or a very fine file held lightly to the tips of the teeth. Continue this process until all the points are just touched. Then file up each tooth by hand with a fine flat file if the teeth are straight, or with a half-round file if they are curved. As a rule, one side, the advancing side, of the teeth is nearly straight. This side must not be filed, and the backs only should be touched.

Wax Polish for Floors.—Cerasin, a mixture closely resembling beeswax, and bought at one-third the cost of the latter, is suitable for polishing floors, but if applied too liberally remains soft or sticky, though this may be somewhat rectified by the use of French chalk. Or paraffin wax may be used. The following is an American preparation for polishing hard-wood floors. Yellow wax, 25 oz.; cerasin, 25 oz.; burnt sienna, 5 oz.; boiled linseed oil, 1 oz.; and turpentine, about 30 oz. Melt the wax and cerasin at a gentle heat; add the sienna if required for staining purposes, if not, it may be omitted. Mix well, and, when cool, add the turpentine in sufficient quantity to bring the mass to the consistency of honey. (See also Series I., p. 143).

Angle Joints for Boxes.—Figs. 2 and 3 show the arrangement of grooving saws on a spindle for making the angle joints of boxes, Fig. 1. Collars exactly equal to the width of the tongues go between the saws (see Fig. 3). To do the grooving satisfactorily, a number of thicknesses of boards must be clamped together and then sawn off flush to the ends to the required length and grooved; or a better plan is to form the grooves in pieces of thick stuff (see Fig. 4), which can afterwards be cut into the thicknesses required.

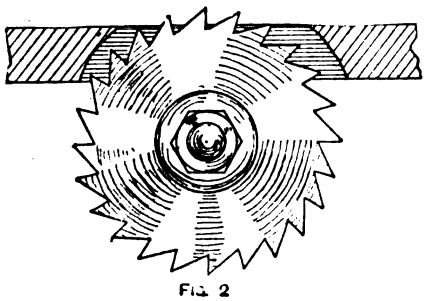


FIG. 2

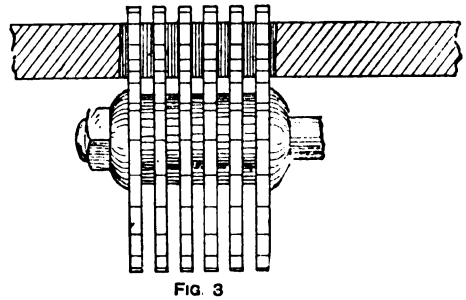


FIG. 3

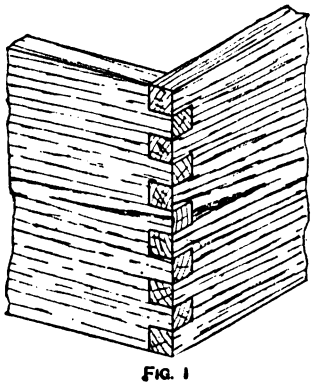


FIG. 1

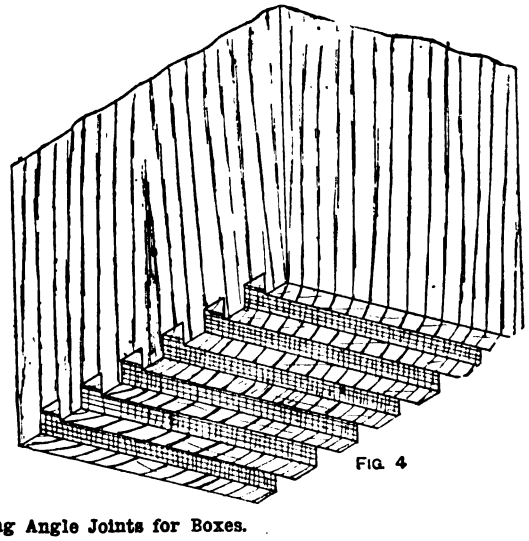


FIG. 4

Making Angle Joints for Boxes.

Hardening and Tempering Watch-lathe Cutters.—To harden the small slide-rest cutting tools used in a watchmaker's lathe, heat them to a bright red and plunge vertically into water. Then brighten one side and to temper them lay the tools in succession on a slip of brass or iron and warm over a flame until a very pale straw colour shows at the cutting portion. With great care the cutters can be ground on an emery wheel dry; or water may be used to keep them cool.

Defects in Photographic Film Negatives.—For repairing injured kodak films, melt down some film that has been scraped off a negative, and stop up holes and cracks by painting them out with this; but the better plan, and that which is generally adopted, is to mix on a palette a little ivory black with a spot of gum, and, making light dots with the point of a No. 2 sable brush, stipple over the defect until it matches the density of the surrounding parts. Do not attempt to fill up the bad place with one dab of colour; the filling must be done with innumerable little dots. Some little practice is required to do the work properly, and a few failures must be expected at first.

Polishing Watch Wheels.—A watch wheel to be polished is secured with shellac to a brass block, and stoned flat and smooth with Ayr stone and water; then it is cleansed and polished overhand with red-stuff and oil on a grain tin flat polishing block.

Repairing Broken Band-saw.—One method of repairing a broken band-saw is by brazing in the following way. File the ends of the saw on opposite sides so as to form two wedge-shaped ends; these should overlap for the length of two or three teeth. Take a small quantity of powdered borax and brass spelter, place it between the ends that are lapped, and damp it a little. Now heat a heavy pair of tongs bright red, scrape off all scale, and close the tongs tightly on the saw where it is to be joined until the spelter runs. A smaller pair of tongs, made warm, is closed on the braze directly the hot brazing tongs are removed. When the joint is well set, remove the tongs and file the saw to uniform thickness. The saw should be clamped in a small holder while being brazed.

Disinfecting a Room.—Scientists differ in opinion as to which is the best fumigant, and even as to whether fumigation is of any use at all. The fumigant that is most in fashion at present is formic aldehyde, but to use it a special apparatus that costs £6 6s. is required. Sanitas is peroxide of hydrogen, and is an oxidiser; it will destroy all putrescent organic matters. The best method of disinfecting a room after a case of infectious disease is to wash all the walls, floor, furniture, etc., with corrosive sublimate, and to boil all linen, etc., in water. The room should afterwards be thoroughly exposed to the fresh air and sunlight for a few days.

Covering Cardboard Boxes. — In cardboard-box manufacture the ordinary method of covering the cardboard with paper is to cut the latter to size, lay it flat upon the bench, and glue with the brush. Glue brushes are much the same as paint brushes and are to be obtained almost everywhere. For very small coverings, instead of gluing the paper a sheet of thin brass or zinc is glued and the paper laid upon it, one sheet at a time, and lifted again quickly; sufficient glue adheres to the surface to make it stick to the box. Some of the larger manufacturers now use gluing machines, sometimes called covering machines. The paper is on reels, and is drawn over a roller which rotates in a glue trough; by this means the paper is glued, the operator meanwhile covering the box. There is also an arrangement for cutting the paper when the four sides of the box are covered. The box is passed to another operator, who cuts the corners and turns in the cover at the top and bottom.

Testing Boilers by Water Pressure.—Cold water is used for testing a boiler by hydraulic pressure. Range boilers are said to be tested to 50 lb. per square inch. Some heating boilers would bear this, but not those with large flat surfaces, like the saddle boiler, for instance. The latter, which is mostly used for horticultural work, is only expected to bear light pressures. The testing is effected with a force pump and pressure gauge; or should the water in a water company's mains be available, the pressure of this may be sufficient without a pump.

Plan of Sailing Punt.—Fig. 1 shows the deck plan of a sailing punt 15 ft. long by 4 ft. beam. It is provided with four seats, the forward one being used for stepping the mast. The stem and stern posts are each 2 in. by

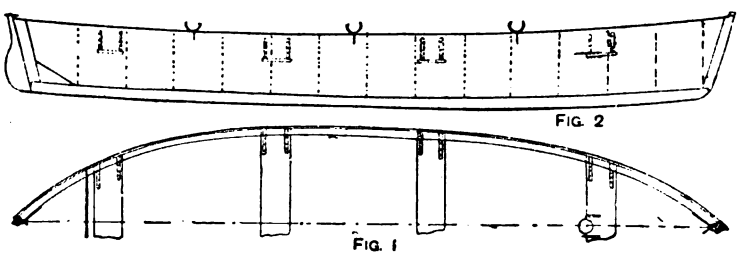
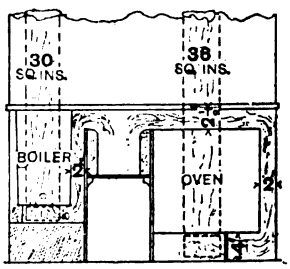


FIG. 2

FIG. 1

Plan of Sailing Punt.



Fixing a Kitchener.

1½ in., and the planking 3½ in. from centre to centre of lap, by ¾ in. thick; twelve planks are used in the half midship girth. Fig. 2 gives the sheer of the gunwale and rise of bottom. This punt should carry three persons on an average draught of 4 in. An ordinary lugsail with an area of 70 sq. ft. could be used. The illustration is drawn ½ in. = 1 ft.

Blocking Letters in Gold on Velvet.—Stamping or blocking lettering and ornaments in gold on velvet is usually done by first blinding in the impression with a very hot tool or stamp. This must be done thoroughly until the impression shows clear and sharp, and every particle of the pile is well laid down. The impression is carefully painted over with hot isinglass, applied with a small camel-hair pencil. When dry, the impression is painted with glaire—a preparation made by beating white of egg to a froth and allowing it to settle. When the glaire is dry, the gold is cut in pieces and taken up on the hot tool and pressed into the impression already made. The gold will adhere and should look clear and bright; any superfluous gold must be carefully brushed away.

Repairing Broken Oilstone.—An oilstone that is broken into two pieces can be rendered serviceable by the following method. Get a piece of well-seasoned mahogany for a case, and mortise it out so that both portions of the oilstone can be fitted in fairly tight. Then, with a mixture of red and white lead, bed both portions of the stone in the case, taking care to keep the broken joint of the stone close. Let the stone stand for a few weeks to allow the lead to become set, after which the surface should be rubbed down with silver sand and water on a flat stone. With careful usage the fracture will scarcely be detrimental to the stone.

Opening Tubes of Gold Chloride.—The correct way of extracting the chloride of gold from the little glass vacuum tubes in which the gold chloride is sold is first to soak off the label in warm water, scratch one side of the tube just above the bulb with a file, and then, holding the tube over a funnel leading into the bottle in which the gold chloride is to be dissolved, break the tube (an easy operation) in two pieces. Place the broken pieces in the bottle, and add the necessary quantity of distilled water. Generally ½ oz. of water to each grain is the usual proportion, so that it is very easy to calculate any required quantities. If any gold should be spilled in the funnel when pulling the tube apart, pour a little distilled water through the funnel.

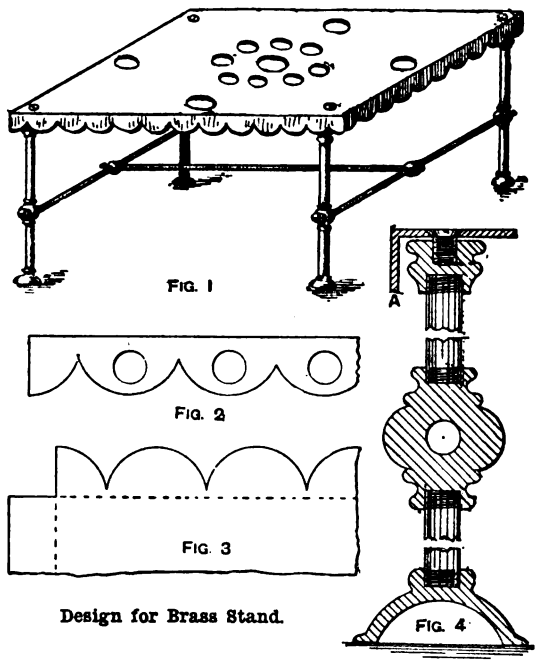
Slow-burning and Smoke-producing Tobacco.—To make tobacco burn without a current of air, dissolve 3 oz. of nitre in 10 oz. of water; steep the tobacco in this for an hour or two, then remove it, press, and dry it on paper in a warm place.

Fixing a Kitchener.—The following is a description of the fixing of a 4-ft. kitchener with one oven and a side boiler. The oven flue passes over the top of the kitchener down the outer side and underneath, all in the full depth of the oven from front to back, or as near the full depth as can be got. The flame passes under the oven and enters the back flue, which begins at the back part of the oven. In passing from the fire round the oven, the flame would hug the back of the flues unless some device were adopted to spread the flame well over the oven plates, this spreading of the flame being necessary in order to heat the oven equally all over. By placing an upright piece of iron, called a mid-feather, in the lower oven flue, the flame is effectively spread all over the oven (the mid-feather is shown in the illustration by a thick black upright line). This mid-feather comes from the back to within about 8 in. from the front, and all flame must pass round the front of this mid-feather before getting to the back flue. The boiler flue is carried down the near side and underneath only, and is not usually provided with a mid-feather, although the boiler would heat better with one. The dimensions of the flues around the oven are given in the illustration, but these dimensions are to a great extent dependent on the range-maker, who sends the oven attached to the front casting. The back flues must also be made to suit the dampers which are sent with the range. The dimensions given in the illustration are sufficient, but the flues may be a little larger if necessary. A most important thing to observe when fixing kitcheners is to make them air-tight. All the air passing into the chimney must first pass through the fire. There must be no openings, crevices, or passages of any kind by which air can enter the chimney without going through the fire.

Mercerised Cotton.—Mercerised cotton is prepared in the following way. The cotton material, which may be hanks of yarn or piece goods, is stretched by passing it on to two rollers which may be drawn apart while revolving, or by some other device. While undergoing this stretching, the material is submitted to the action of a solution of caustic soda of sp. gr. about 1·25; this swells up the cotton and softens it, and, but for the stretching, the threads would become much thicker and shorter. The stretching also produces on the surface of the fibres the striated appearance which renders it somewhat like silk. The alkali must be washed out before the pressure is relaxed.

Care of Cycle Chain.—To take care of a cycle chain, remove it, cleanse it thoroughly by soaking in paraffin, then dry it, and place in an old tin, covering it with about ½ lb. of mutton suet cut up fine. Then place the tin in an oven sufficiently hot to melt the suet. Let the chain lie in this for three or four hours, then wipe carefully and replace it on the machine, finally giving the chain a dusting of graphite well brushed in.

Design for Brass Stand.—Fig. 1 shows an easily made brass stand. Good sizes for the stand are 14in. by 14in.; 18in. by 10in.; or 24in. by 12in. The top is of sheet brass, say No. 16 B.W.G. thick. It should be flattened by hammering on an anvil, which also stiffens it. Fig. 2 shows the vandyke edge ornamented with drilled holes. Cut the plate as shown in Fig. 3. Then turn it down on each side as at A (Fig. 4) by putting it between two flat bars in a vice and hammering it over. This top may be ornamented in various ways; as illustrated, the ornament is made by drilling holes, but saw-piercing may be adopted if further ornament is desirable. The feet are shown in section by Fig. 4. A brass tube ⅜in. in diameter is cut to the length and screwed into the brass sockets at the top and centre, which must be turned and screwed to fit. The feet on which the stand rests are hollow with a solid top, in which the pipe screws. The straining brass under the tubes may be of ⅜-in. brass tube screwed at the ends and fixed through the brass socket with a ball knob outside. This arrangement secures the feet in



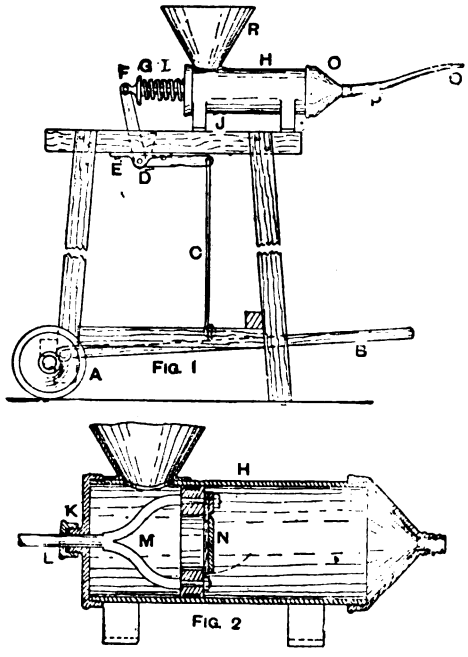
Design for Brass Stand.

position and makes the stand firm. Any ornament may be introduced by screwing to the feet or top. The top is secured to the legs by screws as shown in Fig. 4.

Cleaning and Polishing Zinc.—The only way of improving the appearance of zinc is to clean it thoroughly. One method of doing this is to moisten some fine sand with raw spirit (hydrochloric acid) and quickly scour the metal with this mixture; then wash off the sand and acid with clean water, dry the metal with an ordinary chamois leather, and polish with whiting. A more brilliant polish can be obtained if the oxidised film is removed from the surface of the zinc by scouring with oil and fine emery powder, the oily surface dusted over with whiting, and then cleaned off with a soft duster until the metal is quite bright.

Working Model of Volcano.—The evolution of vapour from a model volcano may be represented by steam, which may be generated in a small boiler of sheet copper placed behind the model and be conveyed to the crater by a small compo pipe, passing below and up through the crater. The steam will come in puffs. If the model is hollow, then an oxyhydrogen or incandescent light placed below will illuminate both the open mouth of the crater and the steam as it passes. A very realistic lava flow may be arranged by running a bright pink silk ribbon over two to four wood rollers or bobbins, one within the crater mouth, another at the foot of the mountain, and the others arranged inside to fit the inequalities of the mountain: the ribbon should be in the form of an endless band, and it should be moved by a handle attached to one of the rollers. It will pass out through the broken lip of the crater, right down the mountain side, then underneath, and back again; its edge should be hidden by a little dried moss representing the vegetation on the volcano. The bombs that are shot out from time to time may be represented by crumpled balls of gilt paper, which are thrown into the cone and are blown out again by the escaping steam.

Poultry-cramming Machine.—Fig. 1 gives a side view of a foot-power cramming machine for poultry, and Fig. 2 represents a section of the cylinder. A trestle is first made of ash of a height that brings the nozzle of the cylinder about 3ft. 3in. above the ground, and this is fitted with a pair of truck wheels A (Fig. 1) for convenience in moving about. A treadle B, made of a piece of ash 3 in. wide by ⅞ in. thick, is pivoted at one end near the axle, and the centre is connected by means of a staple and rod C to a crank lever D. This is jointed to the bottom of the trestle with a couple of brackets E. One arm passes through a mortise in the bottom of the



Poultry-cramming Machine.

trestle, and is connected to the end of a piston rod at F, the hole in the lever at this point being slotted to allow for radial movement. The end of the piston rod is screwed into a bracket G, which may be of cast iron. Between the bracket and the end of the cylinder a spiral spring 1½ in. in diameter, of No. 7 B.W.G. steel wire, is placed for the purpose of forcing back the piston. The cylinder H of the machine may be either a piece of wrought-iron pipe, 3in. diameter, with the feet J riveted on, or it may be a casting, with the feet cast on. At the back of the cylinder is a cap K (Fig. 2), and a boss is cast on the centre of this and screwed for a small cap L, which serves the purpose of making a packed joint for the piston rod, and holding the end of the spring in position. Inside at M, the piston rod is forked to pass through the top and bottom of the piston, to which it is secured with a couple of ⅜-in. nuts. A 1½-in. hole is bored through the piston, and is fitted with a simple valve N, made of a disc of leather backed with a metal plate. A cap O (Fig. 1) of cast iron is screwed to the front of the cylinder, and a rubber pipe P fits on the nozzle of this, where it is secured with a few turns of copper wire. A feeding nozzle Q, varying in size from ¼ in. for chickens to ½ in. for turkeys, is provided at the other end of the rubber pipe. A hopper R, which may be of sheet metal, is riveted to the top of the cylinder at the back end, and into it the semi-liquid food is poured; and it will be clear from the drawings that when the treadle B is pressed down the piston is forced towards the nozzle, sending the food through P; when the pressure is taken off the spring brings the piston back, and the valve N opens, charging the front of the cylinder with food.

Replacing Cracked Piano-bridge.—Before replacing the cracked bridge of a piano, mark round it with a marking awl so that the new bridge can be fixed correctly. It is also a good plan to lay over everything a sheet of brown paper, stretch this tightly, then make an imprint of its shape, position of pins, etc., by gently rubbing with cobbler's black heelball. In most cases the bridges are secured in position from behind by screws, and to gain access to these it will be necessary to take out the canvas backing; the screws, with wooden washers under their heads, should then be seen clearly. Remove the screws, and gently prize off the bridge with a stout chisel or knife. It will be noted that the bridge pins are inserted at an acute angle. The bridge should be made from well-seasoned beech, and, if below the pins, it is cut out in step form so that the strings may stand clear; care must be taken that the new bridge is cut likewise.

Staining Gentles for Fishing.—Either aniline dye, such as Judson's, obtainable in penny packets, or red ink might be tried for staining gentles or maggots red or yellow, but it will be advisable to take the stain in a bottle when fishing, and to dip the gentles in after putting them on the hook, thus keeping the stain from the fingers. Keeping the gentles in sand mixed with red or yellow ochre will colour them to a certain extent.

Jeweller's Show-case.—The details shown in Figs. 1 and 2 will give all particulars as to the proper sizes of material and the mode of construction of a jeweller's

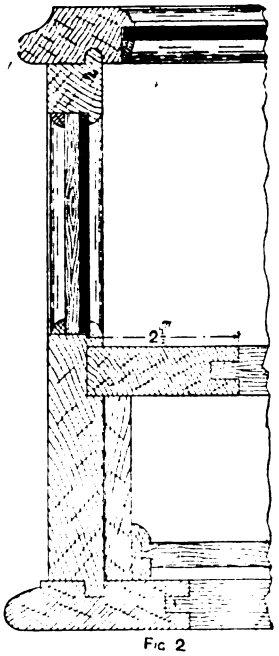


Fig. 2

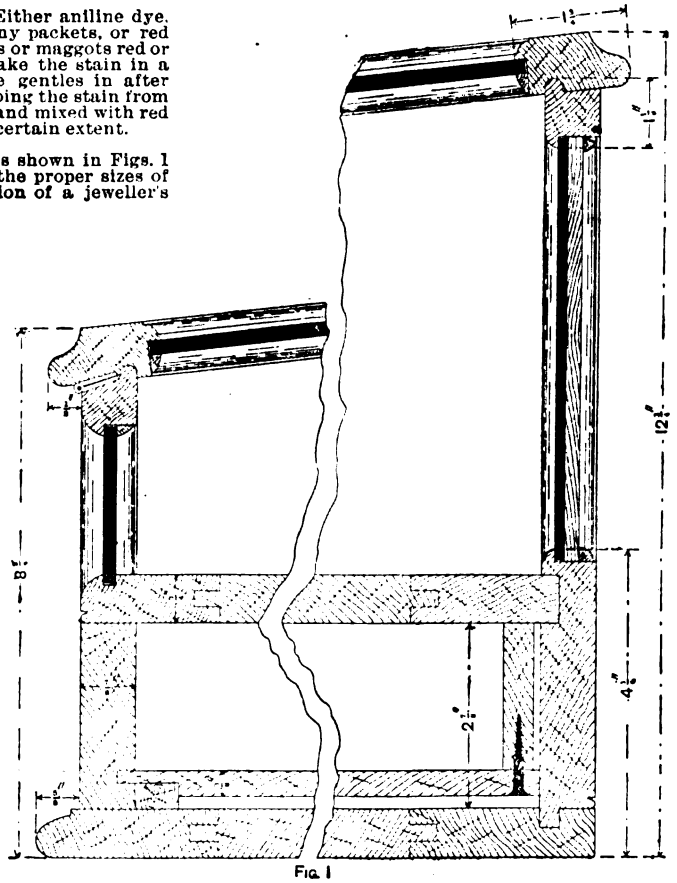


Fig. 1

Jeweller's Show-case.

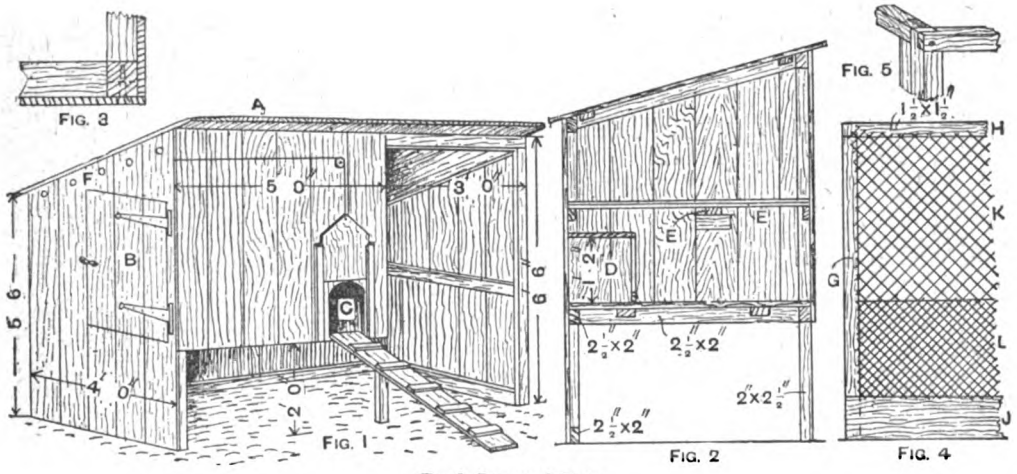
counter show-case. Fig. 1 is a transverse section and Fig. 2 is a section through the end. The illustrations are one-third full size.

Bacterial Treatment of Cottage Sewage.—In cases where there is neither bath nor water-closet in a cottage the daily amount of sewage to be dealt with will probably not be more than 120 gal., and from the manner in which water is used in a household, the discharge will be intermittent. The sewage may be conveniently treated by means of a closed septic tank and a bacterial bed arranged in the back garden of the house or on some neighbouring plot of ground where the sewage works will not be too obtrusive. The septic tank should be a water-tight brick chamber 3 ft. 6 in. long by 2 ft. wide and 3 ft. deep. The inlet for the crude sewage should be by means of a 4-in. pipe bent downwards below water level so as to make a trap excluding air from the interior of the chamber, and the outlet at the other end should be a similar pipe fixed at the same level as the inlet pipe and trapped in the same way. On the top of the chamber a heavy flagstone cover should be laid in cement and covered with earth. The chamber forms a cesspit, which is always full up to the level of the inlet and outlet, and the sewage in it putrifies and is partially decomposed by bacterial action. The effluent from this chamber should be led through 4-in. drain-pipes to the bacterial contact-bed, which may be of very simple construction. A trench 5 yd. or 6 yd. long by ½ yd. wide, and of the same depth, should have two or three layers of large stones, the size, say, of a hen's egg, placed at the bottom. Above this, up to half the height of the trench, should be placed smaller stones, and the upper half of the trench may be filled with hard sharp cinders (not ashes) from which all the fine stuff has been riddled out. Nothing less than ¼-in. gauge should be used. To distribute the sewage over the surface of the bed a V-shaped wooden trough may be bedded in the cinders until the top of the trough is about 1 in. above the cinders. The effluent from the septic chamber is turned down this trough and escapes from notches cut in the sides at intervals of, say, one yard, along both sides of the trough. The far end of the trough is stopped so that all the sewage gets away through the notches with a more or less even distribution over the bed. With this arrangement it will probably be found that the sewage disappears into the ground and is seen no more. Should there be any tendency for the ground to become water-logged in the neighbourhood, a few land tiles may be laid to carry the water away to the nearest watercourse. Valves or mechanical appliances of any kind will not be necessary. When filling the materials into the trench, care should be taken to pack up the sides of the trench as much as possible, otherwise in the course of time the soil will cave in and choke up the interior of the bed. With reasonable care the bed should last two or three years without much attention, and in all probability the cesspit can be left for the same period without cleaning out.

Cheap Varnish for Floors.—A solvent for use in a cheap varnish for floors is good methylated spirit sold at half the cost of wood naphtha. Spirit and naphtha will each require the same amount of gums and resins to give it body, but naphtha, besides being hotter in drying, is more pungent or disagreeable to use, and its chief advantage lies in more rapid drying, especially in cold or damp weather. Spirit is equally effective in a warm room, and should it, as a result of dampness, chill or turn white when in use, the addition of naphtha will often correct it. Shellac and resin are the chief ingredients of cheap varnish; other gums add to the cost and serve no purpose unless they are in sufficient quantities to increase the pliability or wearing quality of the varnish. As a guide, 2 lb. of shellac and 1 lb. of resin to each gallon of spirit or naphtha should be sufficient; it is easy to add more if the varnish is not thick enough, or to thin out with spirit if too thick. Shellac gives body and hardness, resin imparts brightness.

Fowl Pen and Run.—Fig. 1 shows a general view of a pen and covered run to hold about twelve fowls. The house can be built in sections, so as to be easily taken down and moved. The full length (pen and run) is 8 ft., and the covered portion A (Fig. 1) is elevated 2 ft. above the ground to form a shelter in wet weather. A door (not shown) 4 ft. by 18 in. is provided at the back of the open portion of the house, and another door B, 3 ft. by 1 ft. 8 in., gives access to the pen. An opening C, 12 in. by 8 in., is made in the front of the pen for the fowls to enter; this opening may be closed at night by a sliding shutter, as shown. Fig. 2 shows a section of the pen, together with the nest boxes D, and the perches E. The perches should be about 18 in. above the floor of the house, two perches being placed crossways, and one lengthways. The perches should be made of 2½-in. by 1-in. stuff with the edges rounded off, and should rest on battens, so as to be easily removed for cleaning. Four nesting boxes should be provided, each box being about 13 in. square by 14 in. high. A few 1-in. holes F, shown in Fig. 1, suffice for ventilation. The floor of the pen should be of 1-in. matchboarding, the sides, ends, and roof of ¾-in. matchboarding, and the framing of 2½-in. by 2-in. quartering, all of red or white deal. The cost of the timber for the pen will be approximately as follows. For the floor, 20 ft. of 1-in. board (1½d. per ft.), 2s. 6d.; sides, ends, and roof, 150 ft. of ¾-in. board (1d. per ft.), 12s. 6d.; framing, 100 ft. of 2½-in. by 2-in. quartering (1d. per ft.), 8s. 4d.; perches, etc., 1s.; total, £1 4s. 4d. The roof may be covered with felt or simply tarred and sanded, and the inside of the pen as well as the run should be limewashed. To enable the house to be readily taken to pieces the rails of the ends may be notched into the corner post, as shown in Fig. 3, and secured with well-greased No. 16 wood screws turned in through the boarding. For the run, three frames about 8 ft. long by 4 ft. 6 in. high, filled in with wire netting, will be required. Four uprights G 4 ft. 6 in. by 1½ in. square, one top rail H 8 ft. long by 1½ in. square, and one board J 8 ft. by 6 in. by ¾ in. will be wanted for each frame (see Fig. 4). The method of halving the frame together is shown in Fig 5, together with the arrangement of the corners when the run is put together. Wire netting K of 2-in. mesh may be used at the top, and for covering the run, and 1-in. mesh L 18 in. wide should be used at the bottom (see Fig. 4). In putting on the netting, fix the top and bottom pieces to the woodwork with staples, leaving about 1 in. between the pieces of netting; then draw the two edges of the netting together with pliers, and fasten with wire. This will strain the netting tightly on the frames. The timber for the run should cost about ¾d. per ft. run, and all metal fittings, netting, hinges, etc., can be obtained from the nearest ironmonger.

Laying and Jointing Drain Pipes.—For laying and jointing drain pipes the trench should be dug the whole length, and the bottom trimmed and cleared of all loose stuff. A bed of concrete should then be laid to the desired fall for the drain, and pieces dug out of the concrete where the joints will come. After the concrete has set, the pipes should be carefully selected as to straightness, freedom from flaws and irregularities, and the straightest sides marked and laid downwards in the concrete. When in position a bar or lever should be used at the highest end, and all the pipes forced home in the sockets. A pailful of concrete should then be placed behind each socket and carefully packed against the sides of the pipes to hold them in position and prevent them moving when the joints are being made. The joints should then be made in quick succession with good Portland cement (which neither swells nor shrinks when setting) well packed into the sockets from the outside and struck off flush with the outer edge of the socket. An outside fillet of cement, as usually applied, is unnecessary. Slow-setting cement is the best to use, and after from twenty-four to thirty-six hours a water test can be applied. When all is found to be sound the pipes should be covered with concrete. The latter should be allowed to set before the earth is returned to the trench. All ramming should be carefully done to avoid jarring or injuring the drains.



Fowl Pen and Run.

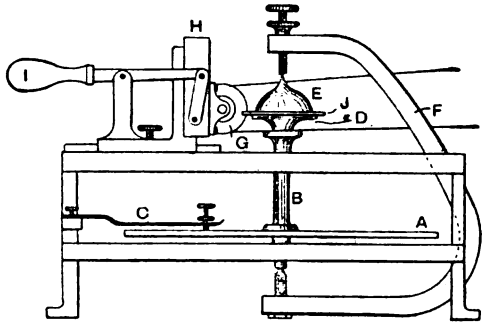
Vandyke Brown.—Vandyke brown was originally an earthy product, but is now mostly of artificial manufacture. The pigment is prepared by calcining the bark of certain trees, and decayed wood; also by mixing vine black, raw sienna, and red oxide, the quantities varying with the shade desired. Vandyke brown is a permanent pigment both in water and oil, and may be depended upon for shade and permanence.

Sizing and Varnishing Postage Stamps.—To size foreign postage stamps treat them with a solution made by dissolving 1 oz. of Russian glue in ½ pt. of boiling water. Next day, varnish with mastic or picture varnish.

Bristles of Paint Brush Shrinking.—The bristles of every paint brush are held in place by the handle, which passes through the shank of the brush and is kiln-dried to fit perfectly. If it shrinks, however, its outward tension is lost and the bristles loosened. For this reason, when the brush is new or not soaking, keep it in a cool place, not in a place possessing any temperature that would tend to shrink the wood of the handle. The dealer as well as the user should keep this point well in mind.

Uses of Cabinet-maker's Steel Scraper.—In capable hands a cabinet-maker's steel scraper is exceedingly useful for smoothing veneered or solid hardwoods that cannot well be finished with the plane. When used on cross-grained or woolly stuff the scraper enables the operator to gain a level finish, whereas a plane would be apt to jump or tear up the surface of the wood. The scraper is also useful for removing French polish or for cleaning up cylinder fronts large hollows, rounds, ogees, and mouldings of hardwoods that have been worked out of the solid; in cases of this kind the steel must be filed into suitable shapes that will enable the operator to reach all portions of the work. The scraper is not used on white pine or deals.

Machine for Cutting Clock Wheels.—The accompanying illustration shows a machine for cutting teeth in clock wheels up to about 4½ in. diameter and of the weight usually seen in house clocks. For turret-clock wheels a heavier machine, more in the form of a milling machine, is needed; or a heavy lathe could be adapted by making a special chucking arrangement for the wheel blanks and rigging up a cutter frame on the slide saddle. The cutters should be of the milling pattern. The wheels of house clocks are cut cleanest by fly cutters; these cutters require a speed of about 100 to 150 revolutions per second, and the cutter spindle must have long bearings with good oil cups. These cutters cut and polish teeth at one operation. The machine shown below has a tripod stand of cast-iron. In this is mounted the division plate A upon a stout spindle B, like a lathe mandrel. The division plate has circles of holes

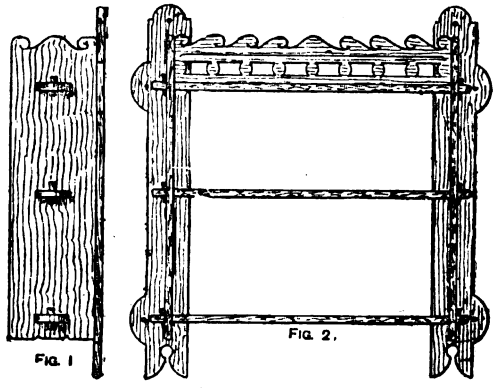


Machine for Cutting Clock Wheels.

and is held by the index C. The top of the spindle B is screwed like a mandrel nose to take a succession of brass seatings D, the tops of which have diameters of from ½ in. to 4 in., advancing in quarters, to suit various sizes of wheel blanks. E is a hollow steel or iron cone, a succession of which is kept to match the seatings D. F is a frame provided with steel centre screws in each end. The use of this frame is to bind the whole together when the wheel is placed in position. To cut a wheel, a seating D, a little smaller than the blank, is selected. The blank is placed centrally upon the seating, the cone E is placed on the blank, and the frame F adjusted and screwed tight. The blank is then tapped true and the frame F finally tightened up; F, passing between two of the legs of the tripod, cannot turn. The cutter spindle G is mounted on a vertical slide H, operated by the hand lever I. J is the wheel blank. The frame holding the vertical slide H is itself mounted on a sliding foot to approach or recede from the spindle B. If the machine is also required to cut bevel and contrate wheels, the frame carrying H is jointed at its base for adjusting to a bevel, and its sliding foot is provided with a hand lever for cutting contrate wheels.

Paper for Making Photographic Blue Prints.—For making blue prints from photographic negatives, make up (A) a 25-per-cent. solution of ammonium ferri citrate, and (B) a 25-per-cent. solution of potassium ferricyanide (or ferridcyanide). Before dissolving the ferricyanide it should be rinsed in warm water to get rid of any yellowish powder adhering to the crystals, which after rinsing should be of a bright ruby colour. After dissolving the ferricyanide, take a small portion of the solution, dilute it to say one-tenth of its strength, and to this diluted solution add a small quantity of a solution of a ferric salt, such as ferric chloride. If a dense dark blue precipitate forms in the ferricyanide solution, the presence of ferrocyanide (yellow prussiate) of potassium is indicated, or it may be that the ferric chloride is partly in the ferrous state. If the precipitate is a slight one it may be disregarded, as it is almost impossible to exclude the precipitate altogether; a light blue colour would indicate that the solution is in its proper condition. To ensure the ferric condition of the iron it is advisable to add a little oxalic acid to the ferric chloride (in the proportion of 1 to 2) before making the test. If the water used is hard, a little citric acid should be added to the potassium solution. Having ascertained the condition of the potassium ferricyanide, dilute a small quantity of ammonium ferri citrate solution, and test it with a few drops of the B solution. If a blue precipitate appears the iron is in an improper condition, and should be rejected for another sample. Photographic chemists sell a specially preserved form of the ferric citrate. The solutions should preferably be prepared immediately before use. The paper may either be brushed over with or soaked in the solutions; the latter method yields the more vigorous prints. The paper should be dried by a gentle heat.

Light Bookshelves.—Excepting a single piece, the set of shelves shown by Figs. 1 and 2 is made throughout of ¾-in. deal planed down to ½ in., the exception being the strip of fretwork above the upper shelf, which should be of ¼-in. board. The shelves are framed together upon the two flat back pieces (see Fig. 2) by which they will be screwed or nailed to the wall. These back pieces are 2 ft. 3 in. long by 4 in. wide, and to them are screwed the side pieces (see Fig. 1), which are 1 ft. 10 in. long by 6 in. wide; these are pierced by three mortises, measuring 2½ in. by ½ in., for the tenons of the shelves; the lowest



Light Bookshelves.

mortise is 1½ in. from the bottom, from this to the middle mortise is 8½ in., from the middle to the top mortise is 7 in., whilst above the top mortise the piece rises 3½ in. The three shelves are 6 in. wide, and measure 1 ft. 8 in. from shoulder to shoulder, beyond which the tenons project at each end 1½ in., being fastened by pegs: the ends of the tenons are rounded off. The fret-cutting runs above the upper shelf from side piece to side piece, thus converting the top into a kind of ornamental gallery for china or other bric-à-brac. It is 3½ in. wide by 1 ft. 8 in. long, and its lower edge is dowelled to the shelf, whilst a couple of small round-headed screws through each of the side pieces fix its ends. This artistic little piece of furniture may be polished either with or without first staining, or it may be enamelled.

Cleaning New Paint Brushes.—New brushes should not be dipped in the paint and put to work without first being cleaned. By working them with a brisk movement back and forth through the hand most of the dust and loose hairs will be taken out. A paint brush, when thus thoroughly "dry cleaned," should be placed in water for a few minutes, but not long enough to soak or swell it, but only until wet through, and then swung and shaken dry. It is then ready to dip in the paint, and although some of the hairs may still be loose, most of them will come out in the first few minutes' working, and can be easily picked from the surface.

Cleaning Brass Castings with Acid.—For an acid that will clean small brass castings heat till nearly boiling equal parts of water and concentrated nitric acid; in this suspend the articles on wires for a short time, when the acid will dissolve off a thin layer of the brass, leaving it bright. If this is not found strong enough, take 1 part of strong nitric acid and add 4 parts of strong hydrochloric acid. This mixture will rapidly eat off the outside skin of metal.

Cutting and Trimming Edges of Books.—A machine is used for this purpose, but the work can be done by hand. After a book has been sewn and the back glued up, while still flat place it on a wooden board (such as a backing board) on the bench, and on the top of the book lay the other board, which must have a perfectly straight edge. This edge is laid to a mark previously made on the book, showing how much is to be cut off, a piece of cord is passed round, and the whole tied up tightly. With a shoemaker's knife trim the edges carefully, using the top board as a guide. The knife should be frequently sharpened on a sandstone. Another method is as follows. Before sewing the book, cut all the numbers separately, using a knife and a straightedge. Then with a pair of compasses or dividers make two marks on each edge, marking from the printed matter outwards. Lay the straightedge to these marks and cut carefully. Each of the above methods requires care and patience.

Adjustment for Toilet Glass.—A method by which a mirror or toilet glass can be prevented swinging out of its fixed position is illustrated below. Stretch a piece of fine eye-glass cord around the uprights A (see illustration) from which the glass is suspended, so that the back

Adjustment for Toilet Glass.

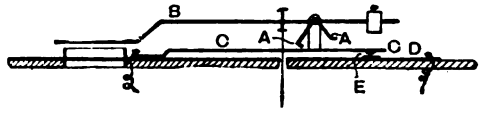
of the mirror frame rests against the cord. The angle at which the mirror is required to remain is obtained by sliding the cord up or down the uprights. Should the latter be of an ornamental character and the mirror heavy, replace the supporting cord by strong tape or ribbon of colour similar to that of the wood, and provide it with a small buckle, placed so that it is easy of access.

Determining Diameters of Discs on Lantern Screen.—The methods of determining the distance of an optical lantern from a screen, the diameter of the disc of light, and the focal length of the object lens, any two of these quantities being known, is explained below.

Knowing A the focal length in inches of the lens and B the diameter in feet of the desired disc, to find the proper distance in feet which the lantern should be from the screen, proceed thus. Multiply A by B, and divide the product by 3 (the diameter in inches of the slide aperture). Thus, with a 6-in. lens and a 10-ft. disc, the distance would be 20 ft. $\left(\frac{6 \times 10}{3} = 20\right)$. Knowing the distance A and the focal length of the lens B, to find the diameter of the disc, multiply 3 (the diameter in inches of the slide) by A, and divide the product by B. Thus, at a distance of 30 ft., a 9-in. lens would give a 10-ft. picture $\left(\frac{3 \times 30}{9} = 10\right)$. Knowing the distance A and the diameter of the disc B, to find the focal length of the requisite lens, multiply A by 3 and divide the product by B. Thus, at a distance of 30 ft., for the production of a 9-ft. picture a 10-in. lens would be necessary $\left(\frac{30 \times 3}{9} = 10\right)$. The accompanying table shows at a glance the distances at which lenses of certain focal lengths should be used to produce discs of certain diameters.

Strength of Joists.—A common rule for strength of fir joists in a dwelling-house is depth in inches = ½ span in feet + 2, and thickness = ⅓ depth. Thus for 12-ft. span, the calculation would be 6 + 2 = 8 in. deep, and 8 ÷ 4 = 2 in. thick. The strength of beams varies as the breadth multiplied by the square of the depth; therefore the comparative strength of 8 × 2 is 2 × 8^2 = 128, while 7 × 2½ is 2½ × 7^2 = 122½, being very nearly equal in strength but not in stiffness.

Electric Alarm for Incubator.—An electric bell may be fixed to an incubator to ring when too much or too little heat is being used, because with the regulator open the heat will occasionally rise too high. By referring to the illustration it will be easy to understand the



Electric Alarm for Incubator.

electrical arrangements. The regulator is shown just open, as it should be in practice; A is a piece of wire bent as shown and soldered to the end of the cross piece of the regulator B. When the regulator descends or rises excessively by variation of the heat it causes A to press on a spring of very thin strip brass C, and this makes contact with D at E, thus closing the circuit and ringing a bell.

Electro-silvering a Sword and Sheath.—Two vats, each not less than 4 ft. long and 1 ft. 6 in. wide, will be necessary for electro-plating a sword and sheath. Fill one with an alkaline coppering solution, and the other with the silver cyanide plating solution. The sword must be freed from grease, etc., by scouring in the potash pickle, then lightly coated with the alkaline coppering solution, rinsed in clean water, quicked in a cyanide of mercury solution, and lightly silvered in the silver-plating solution, then scratch-brushed and polished. The sheath must be treated in a similar manner, but care must be taken to remove first the wooden strips which form the lining. To do this, it will probably be necessary to take out a set screw in the collar, and remove this, then loosen the strips of wood with a knife and draw them out. A plug of wood should be put in the screw hole, and the head of the screw should only be lightly plated. Both sword and sheath must be slung horizontally in the baths, and the sheath should be given a heavier plating than the sword.

Distance between Lantern and Screen.	FOCAL LENGTH OF OBJECT LENS OF LANTERN.																					
	4 in.		5 in.		6 in.		7 in.		8 in.		9 in.		10 in.		11 in.		12 in.		13 in.		14 in.		15 in.	
	DIAMETER OF DISC OF LIGHT ON SCREEN.																					
Feet	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.
10	7	6	6	0	5	0	4	3	3	9	3	4	3	0	2	9	2	6	2	4	2	2	2	0
11	8	3	6	7	5	6	4	9	4	2	3	8	3	4	3	0	2	9	2	6	2	4	2	2
12	9	0	7	2	6	0	5	2	4	6	4	0	3	7	3	3	3	0	2	9	2	7	2	5
13	9	9	7	10	6	8	5	7	4	11	4	4	3	11	3	7	3	3	3	0	2	9	2	7
14	10	6	8	5	7	0	6	0	5	3	4	8	4	2	3	10	3	7	3	3	3	0	2	9
15	11	3	9	0	7	6	6	5	5	8	5	0	4	6	4	1	3	9	3	6	3	3	3	0
20	15	0	12	0	10	0	8	7	7	6	6	8	6	0	5	6	5	0	4	7	4	3	4	0
25	18	9	15	0	12	6	10	9	9	4	8	4	7	6	6	10	6	3	5	9	5	4	5	0
30	22	6	18	0	15	0	12	10	11	3	10	0	9	0	8	2	7	6	6	11	6	5	6	0
35	26	3	21	0	17	0	15	0	13	1	11	8	10	6	9	6	8	9	8	1	7	6	7	0
40	30	0	24	0	20	0	17	2	15	0	13	4	12	0	10	10	10	0	9	2	8	6	8	0
45	33	9	27	0	22	6	19	3	16	10	15	0	13	6	12	3	11	3	10	4	9	8	9	0
50	37	6	30	0	25	0	21	5	18	9	16	8	15	0	13	8	12	6	11	6	10	9	10	0
60	—		36	0	30	0	25	8	22	6	20	0	18	0	16	4	15	0	13	10	12	10	12	0
70	—		42	0	35	0	30	0	26	3	23	4	21	0	19	1	17	6	16	2	15	0	14	0
80	—		—		40	0	34	3	30	0	26	8	24	0	21	10	20	0	18	5	17	2	16	0
90	—		—		—		38	7	33	9	30	0	27	0	24	6	22	6	20	9	19	3	18	0
100	—		—		—		42	10	37	6	33	4	30	0	27	3	25	0	23	1	21	5	20	0
125	—		—		—		—		—		41	8	37	6	34	1	31	3	28	10	26	9	25	0
150	—		—		—		—		—		—		—		40	11	37	6	34	7	32	2	30	0

Railway Wagon Axle-boxes.—To make an axle-box for a railway wagon with springs 4 in. wide, hoops on the same 3 in. by ⅝ in., guards 9 in., and journals 8 in., foundry patterns are necessary. Make a model of the outside of the box, Fig. 1 giving a plan, and Fig. 2 a side elevation. This must be cut in two portions on the line at A (Fig. 2), and the lower part secured to the upper with dowels, as shown by the dotted lines. The pattern must be made a full $\frac{1}{16}$ in. in a foot larger every way, to allow for the shrinkage of the metal when cast. Where the openings in the box occur, prints must be attached to the pattern; thus B is the print for the back opening, C for the grease chamber, D for the journal bolt, E for the vertical holes, and F for the lid pin. Next core boxes must be made for the inside of the box. Figs. 3 and 4 show one for the grease chamber; it consists of a box made in two portions A and B (Fig. 4) secured together with dowels. The recess is made an exact model of the inside of the grease chamber, and is rammed full of sand by the moulder in the foundry, as shown by the dotted portion. When the impression of the outside of the box has been taken by the moulder in the sand, C (Fig. 3) on the core will fit in the recess left by the print C (Figs. 1 and 2). Fig. 5 shows half the core box for the lower portion of the axle-box. In this prints are put at G to form recesses for the ends of the cores G (Fig. 3) that form the grease holes. The portions of the cores B and D (Fig. 5) will fit in the recesses left by the prints B and D (Figs. 1 and 2). In the case of D the print has to be brought up to the parting line to enable the moulder to draw the pattern from the sand, and he will have to make up the mould to the correct shape when the core is in position. The same must be done with regard to the lid pin hole F. Cores must also be made to fit into the recesses left by the prints E for the vertical holes. Axle-boxes are often made bottomless, and when this is the case the box (Fig. 5) may be dispensed with, the pattern being recessed to form the inside of the box, and the parting line kept higher up. The pattern should be tapered slightly from the parting line to enable the moulder to withdraw it easily from the sand. The lid should be made in wrought or malleable cast-iron.

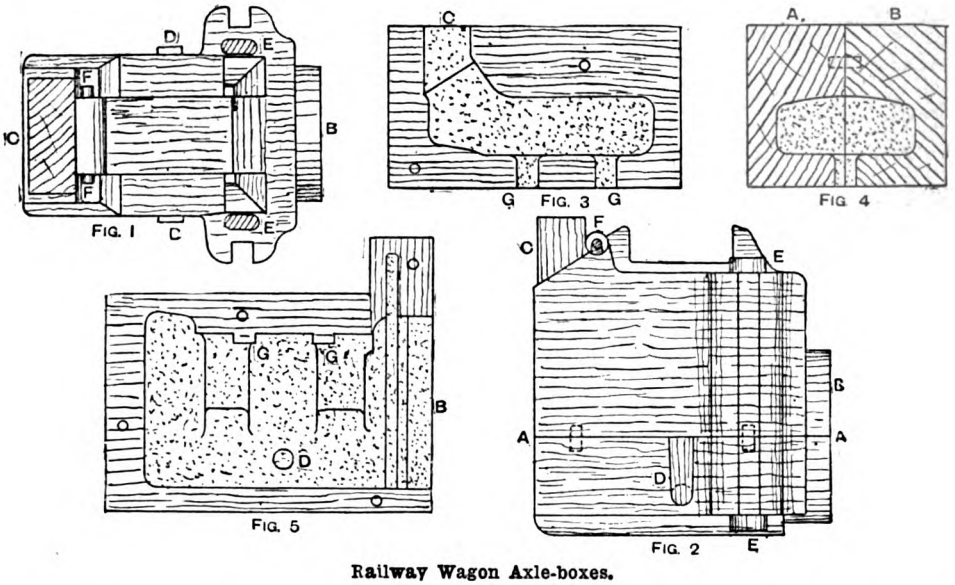


FIG. 1 FIG. 3 FIG. 4 FIG. 5 FIG. 2

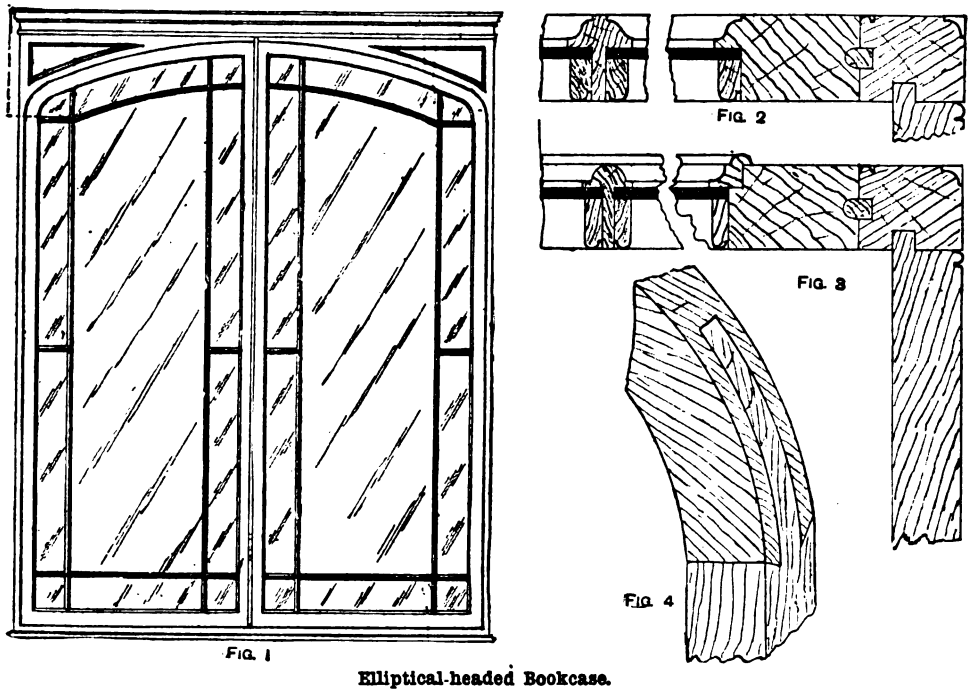
Railway Wagon Axle-boxes.

Making Rectilinear Photographic Lens.—It is probable that all a beginner will be likely to succeed in making will be a periscopic rectilinear lens, and the making of this, though it will doubtless have some educational value, in other respects will not pay for the trouble. Instructions on making a properly corrected achromatic lens cannot be easily conveyed in writing. Briefly, however, the glass (moulded to the approximate shape) is worked down to near the curve, then fastened with pitch to the lathe, and roughed out or rubbed with a tool of proper curvature (concave for a convex surface) covered with different grades of emery. It is finally polished with putty powder on silk, or a better plan is to warm a little pitch and smear over the surface, run the two tools together, and spread on the putty powder. The tools are made by first cutting from sheet brass two gauges of the required size. For example, if the required lens surface has a radius of 5 in., then the diameter of the circle of which this surface is a segment will be 10 in., and a 10-in. circle must be cut. The outer piece is cut in two, and forms the gauge for the convex side; the tools are then turned in brass to fit these gauges. The tools may be purchased, as also may the simple ground uncorrected and uncentred lenses (the latter at 6d. each). The following formulæ will indicate an approximate, but probably sufficiently accurate, method of calculating the curves, etc. Plano-convex: $F = 2r - \frac{1}{4}T$, where F = focus, r = radius, and T = thickness of lens. Double convex: $F = r$. Crossed lens: $F = \frac{(r \times r^1)^2}{r + r^1}$. Meniscus: $F = \frac{(r \times r^1)^2}{r - r^1}$. Centering is effected by reflecting the flame of a candle and rotating the lens. If the centering is correct, the image will remain stationary. If the image does not remain stationary, the lens must be slid about until the desired effect is secured, and then the surface must be edged down accordingly. To fit up a lens for practical trial, take two 20-in. lenses of plano-convex form. The combined focus of any two lenses is found by multiplying the two together, and dividing by their sum minus the distance of separation. Mount the lenses in a temporary card tube, in any convenient way so that they may be adjusted for separation, about 2 in. apart. The position of the lenses and stop should be found by experiment, and will be governed by their covering power or general qualities. The best place will probably be where the lens illuminates the margins and no more. In using such a lens the difference between the chemical and the visual foci should be ascertained, and the focussing screen fixed at this distance nearer the lens. These lenses are only to be used for fairly distant objects, when the difference remains fairly constant.

Cleaning New Varnish Brushes.—New varnish brushes, and brushes used in varnish stain and in all colour in varnish, before using for the first time require to be thoroughly "dry cleaned" in order to work out all loose hair. Dry cleaning is done by working them through the hand, and then it is a good thing to pass the brush backwards and forwards over a sheet of sandpaper, whose rough surface pulls out the loose bristles and smooths down the rough ends of the chisel point. The brush then should be washed by working it for a few minutes in clean turpentine and then swinging it until dry. Varnish brushes should never be put in water. For carriage work and first class varnishing the brush should be "broken in" on the first and second coats so as to work out all the dust particles; then it may be used on the last coat. Well-used brushes are best for applying the finishing coats of superior work.

Cement for Fixing Tiles on Washstand Top.—Plaster-of-Paris is generally used for bedding tiles on to a washstand top, but it is a fact that Portland cement resists the action of the water much better. If the dark appearance of the cement is objected to, the joints can be raked out to a depth of about ¼ in. and then pointed with plaster-of-Paris. But this material soon presents a dirty appearance.

Elliptical-headed Bookcase. — The illustration, Fig. 1, is an elevational view of the front of a bookcase with an elliptical or three-centre head; the doors are hung folding with a hook joint in the rebate. The hanging stiles have air-tight beads, the ends being solid and tongued to the frame, which is made of solid mahogany. The doors have marginal bars, and the top ones follow the line of the rails. The bars are made as shown in Figs. 2 and 3. Whichever method is adopted, either the moulding stuck on the solid, or the bolection moulding being planted on the frame, the construction will be the same, except that if the bolection moulding is used the doors may be made in pine and veneered with mahogany. In framing the top elliptical rail to the stile at the springing, the rail should be housed to receive the tenon on the stile as shown in Fig. 4 and well glued. The end which is framed to the meeting stiles will be mortised and tenoned as usual; the bars also are framed in the same way. It is a matter of taste between a flush moulding and a bolection, either being suitable. If the work is to be done by hand, the flush moulding worked on the solid will be found much the easier.



Elliptical-headed Bookcase.

Wiped Joint between Lead and Cast-iron Pipes.—In wiping a lead pipe to a cast-iron pipe perhaps the best practice is to file clean the end of the cast-iron pipe first and then coat with pure tin, sal-ammoniac being used as a flux. The pipe then is washed to remove the sal-ammoniac, and afterwards retinned, using resin and grease as a flux. A plumber's joint then is wiped in the usual way. It is necessary to take great pains to make a good sound strong joint between the two metals, but even then in the course of time (it may be only a few years) the iron will come out of the solder. The first sign of decay will be a red ring of iron rust showing at the end of the joint. This rust will swell a little and cause the end of the soldering to slightly curl outwards. Eventually the rust will creep between the solder and the iron and destroy the adhesion of the one to the other. Only those metals that alloy together can be satisfactorily joined by soft soldering, and the solder should contain as great a proportion as possible of the metals that are to be united. The joint would, if out of doors, be subjected to temperatures ranging over 90° F.; under such conditions the solder of a 3¼-in. wiped joint on a 4-in. pipe would expand ·001251 in., and the iron would expand ·000549 in., or less than half as much as the solder. The joint would therefore eventually become a loose ring on the iron pipe, but not on the lead pipe, as the expansion of lead and solder do not differ to any great extent.

French-polishing in Cold and Damp Weather.—When French-polishing a staircase or interior work in new houses in cold damp weather there is always a risk of the polish chilling or turning white, with a liability to peel off when subjected to much friction; it is also nearly impossible in such circumstances to impart a perfect gloss or finish to the work. This annoying result may be minimised to a great extent by using a stronger solvent for the shellac and gums; wood naphtha should be used instead of methylated spirit, the polish being applied rather sparingly, and the varnish thinned out. The polisher's aim should be to work the handrail up in short sections rather than in long sweeps, and to work each rubber out fairly dry before applying more polish. The newels should be treated in the same manner, the surface being built up by several applications of thin varnish rather than by one thick coat. Should, in spite of these precautions, the polish or varnish be chilled, warmth of some sort must be applied. The heat given out by a naphtha lamp as used by showmen is often effective; the burning-off lamps as used by painters are not so good. The better plan is to use a charcoal fire, and a basket for holding such a fire can be easily made out of thin sheet iron. The fire basket must not be allowed to remain stationary near the polished surface of the work, nor must the heat be applied direct to the lac surface; it will be sufficient for the purpose if the surrounding air is slightly warmed. When naphtha is used as a solvent for the lac and for clearing or spiriting out, a little more oil should also be added.

Bronzing Soldered Joints.—To bronze the soldered joints on a brass fitting by a superficial coating, it is necessary to varnish the soldered parts with a thin coating of gold size, and while the latter is still wet, dust over the moist parts with bronze powder until the whole of the soft solder is hidden. When the gold size has set hard, the bronze powder will be found to have firmly adhered to it, and the surface may then be rendered smooth by very lightly rubbing with a burnishing tool.

Care of Paint Brushes.—It is most important not to leave paint brushes on end while at rest. At night they should always be placed in a "brush keeper"—a water-tight box, or a paint keg, with nails driven through the sides on which the brushes can be suspended in water. Holes are bored in the handles so that the brush may hang free of the bottom, but with the bristles entirely under water. Before placing them in water, wipe off surplus paint, but do not clean them. Even for temporary rest during a job, the brush should not stand on end.

18-ft. Sailing Boat.—The accompanying lines and details are of a boat 18ft. by 6ft. by 2ft., fitted with a centre-board. Fig. 1 shows the sheer and body plans. Fig. 2 is the deck and half-breadth plan showing the arrangement of the well. The illustrations are to a scale of ½in. equals 1ft. The stem is of larch, 3in. by 1½in., and the transom either of teak or larch 1½in. thick. The half section is formed of two yellow pine boards ¾in. thick, connected at the top of the floor and keel to 1½-in. by 1½-in. pitch-pine fore and afters by means of screws. The timbers are of 3-in. by ½-in. pitch pine, spaced 1ft. apart. The centre-board case trunk logs are of 1½-in. by 3-in. oak, and project 12in. forward and aft of sections 2 and 5 to form scarfs for the centre fore and after. Two uprights, 3in. by 1½in., are inserted and secured to the trunk logs. The sides of the case are of ¾-in. pitch pine, with a slot 2in. from the top at A, to take a ½-in. bolt with fly nut. Two thwarts B and a fore and after of 12-in. by ¾-in. mahogany are fitted; the fore and after sits on top of the centre-board case, and has a 1½-in. slot up the centre for the centre-board. This is 1in. thick, and is fitted with lead C to keep it down. The rudder is 1in. thick, and is shaped as shown in Fig. 1. The deck is planked with yellow pine 3in. by ½in.; the plank in way of the mast is of 9-in. by 1-in. oak. A ½-in. teak grating is fitted in the well, round the centre-board case. The mast is 16ft. high and 4in. in diameter at the deck, tapering to 2in. at the head. The sail area is 190sq.ft.

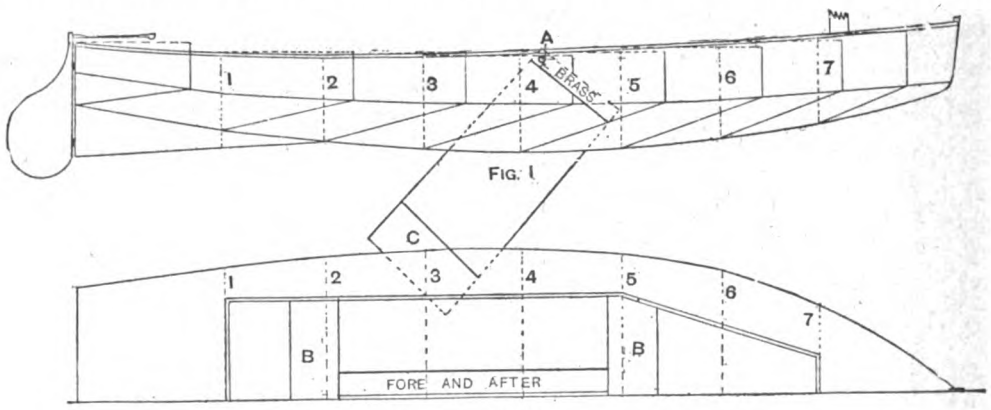


FIG. 1

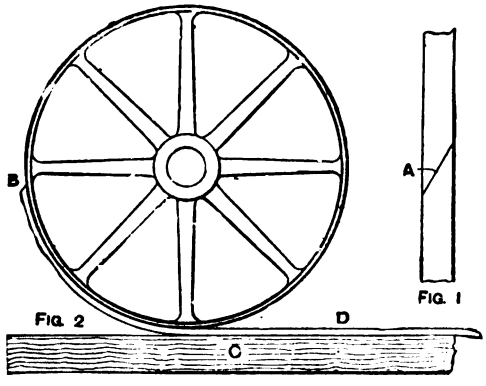
FIG. 2

18-ft. Sailing Boat.

Lithography, Transfer Ink and Paper.—Lithographic transfer ink may be made by mixing 2oz. each of tallow, shellac, and Castile soap with 2½oz. of virgin wax and ¼ oz. lampblack mixed with boiled linseed oil. Place the tallow and wax in an iron saucepan, and heat them until they catch fire. Cut the soap into small cubes, and add to the mixture cube by cube, allowing each piece to melt before adding another, and stir the mixture continuously. All the soap having been dissolved, the mixture must be allowed to go on burning until it is reduced to its original bulk. Take care that the pot is not allowed to boil over; remove the saucepan from the fire whenever this danger becomes apparent. Then add the shellac and extinguish the flame by putting on the lid of the saucepan. Ascertain that all the ingredients are thoroughly dissolved; then add the lampblack, which, as previously mentioned, has been mixed with boiled oil. The ink can then be cast or moulded in paper cylinders, or poured on to a marble slab previously rubbed with soap to prevent adhesion, a similar slab being placed on top of it when it is beginning to cool. The ink can afterwards be cut to convenient shapes for use. To make transfer paper, dissolve ½ oz. of gum tragacanth in water. Strain it, and add 1 oz. of glue and ½ oz. of gamboge. Powder and sift 4 oz. of French chalk, ½ oz. of spent plaster-of-Paris, and 1 oz. of starch. Thoroughly incorporate these materials with the others, and add enough water to reduce the mixture to the consistency of syrup. Then apply it evenly with a brush over thin paper. The transfer ink may be rubbed down in a saucer, and either a quill or a steel pen may be used for writing. Although recipes have been given for making the ink and the paper for transfers, it will be found cheaper and more convenient to buy all the materials ready made. The ink-making is a messy and dangerous operation. The prepared surface of the paper must not be touched by the hand; every finger-mark would cause a blemish. Warm the prepared stone to about 120° F., or rather more. Slightly damp the back of the transfer, and lay it face downwards on the stone. Place three or four pieces of paper over it, and then put it under the press half a dozen times, taking care not to shift the paper, or the transfer will be ruined. Remove the impression sheets, damp the back of the transfer paper, and carefully remove it from the stone, which should then present a clear impression of the writing. Now carefully cover the surface of the stone with gum water. Then etch in the design by pouring weak aquafortis (1 part to 100 parts of very weak gum-wa r), allowing the wash to run freely over the stone by sloping the latter in various directions in much the same way as a photographer floods a plate. Then wash the stone with cold water until the acid is cleaned off, and finally float some more weak gum-water over the surface. Have ready some lithographic printing ink, properly distributed over an inking surface by means of a printer's roller. Damp the stone with a sponge dipped in cold water. Then roll up the image or writing with the ink. It may be here explained that the process of lithography is based on the affinity of fats, and on the antagonism between oil and water. What happens when the stone is rolled up is that the image or writing, formed chiefly, as has been seen, with fat as a pigment, takes up the oily printing ink, whereas it had previously repelled the water; while the water repels the printing ink. Next adjust the paper on which the printing is to appear, and take the impression. The watering, as well as the inking, must be repeated at each impression. The process is, unfortunately, not nearly so simple as it appears, and really good work cannot be obtained until the operator has acquired considerable experience. It is of course possible to draw or write on the stone direct, without the use of transfer paper; but then the image must be made in reverse, and the process is attended by other inconveniences that would tend to discourage a beginner.

Cyphering in American Organ.—If cyphering occurs in an organ placed in a damp room or against a damp wall, turn over the keys, when probably some of the plungers under them will be found swollen and sticking in the holes. They must be taken out, and eased with fine glasspaper till free, and then rubbed with French chalk. The organ should be set in as dry a place as can be found, and should have a thick woollen cover shaped to the case, and reaching to the floor. If the cyphering occurs at concerts when the room is hot and crowded, there is not any remedy, and a harmonium must be used, as an American organ will not stand without deterioration in a hot and crowded room.

Fixing Bands to Band-saw Wheels.—For fixing a rubber band to a band-saw wheel, cement is used; to make the cement, melt and well mix 1 part of gutta-percha with 2 parts of pitch. Heat the rim of the wheel, give it a thin, hot coat of the composition, and quickly spring on the band. Tightly bind with strong cord the whole breadth of the band, and place aside until the cement is well set. To secure canvas or leather to the rims, first give the rims a thin coat of lead-colour paint and allow it to dry. Soak some good glue in cold water until soft, then dissolve the glue by heating gently in vinegar. Mix with this about one-third of white turpentine, and apply hot to the rim of the wheel; press the canvas tightly on the rim and put aside until the glue is hard. If desired, good brown leather, well stretched, may be used as a substitute for rubber. The ends of the leather should be cut on the slant as at A (Fig. 1), and both ends slightly undercut as at B (Fig. 2). The leather must be of uniform thickness throughout its length and breadth, or frequent breakages of saws will occur. In fixing the leather on the wheels the following method may be adopted. Place a batten C (Fig. 2) on the floor, and the leather D on the batten. One person with a brush should coat the rim of the wheel with the glue, while another rolls the wheel on the strip of leather, pressing the wheel firmly while it is being turned (see Fig. 2). See that the ends of the leather are glued so as to make a good join. After the leather is fixed on the wheel, bind it with strong cord, place aside, or hang in position on the machine until the glue is hard; then

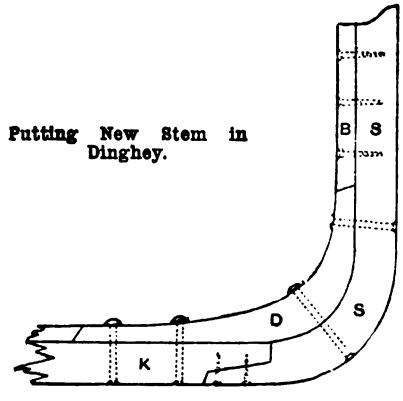


Fixing Bands to Band-saw Wheels.

remove the cord, and clean off surplus glue. If desired, rubber bands may be sprung on the leather and secured with the guttapercha and pitch solution mentioned above.

Preserving Papers with Zapon Varnish. — Some years ago Schill, a German, invented a process, known as zapon impregnation, for the preservation of paper from the destructive influences of the atmosphere, of water fungi, and light, but especially from the consequences of the process of moulding. The first aim of the inventor was the preservation and improvement of manuscripts and old printed matter, but the invention, besides answering this purpose, can be employed in all cases in which the decay of important documents, books, charts, drawings, etc., is to be forestalled, and also when the sizing of the paper is to be strengthened, and its liability to tear is to be reduced. By this process plans and maps for the use of builders' foremen and travellers can be strengthened and preserved. The zapon can be applied either by dipping the papers in the zapon or by brushing it on. Zapon in a liquid state is highly inflammable, and for this reason the zaponising process should be carried out away from open flames and fires. The zapon takes a few hours to dry when both of the sides are coated, and the zaponised paper does not ignite at an open flame any more readily than non-impregnated paper. For coating with, and especially for dipping in, zapon, a contrivance which effects a convenient suspension and dripping off with collection of the excess is of advantage. The zapon should be thinned according to the material to be treated. Feebly sized papers are coated with undiluted zapon. For dipping purposes, the zapon should be mixed with a diluent if the paper is hard and well sized. The weaker the sizing the more careful should be the selection of the zapon. Unsized papers require an undiluted coating. For important manuscripts an especially carefully prepared kind of zapon varnish is recommended, which does not render the paper translucent, but imparts to it special softness. The zapon to be used for coating purposes should be particularly thick, so that it can be thinned as desired. Thick and undiluted zapon is an excellent cement for wood, glass, porcelain, and metals, as it is insoluble in cold and hot water, and binds very firmly. Metallic surfaces coated with zapon lacquer do not oxidise or alter in appearance, since the coating is like glass, and only forms a thin but firmly adhering film, which, if applied to pliable sheet metal, does not crack on bending. For the preparation of zapon the following directions are given. Pour 20 parts of acetone over 2 parts of colourless celluloid waste, and stand it aside for several days in a closed vessel, shaking frequently, until the whole has dissolved into a clear thick mass; this is celluloid varnish. Now add 78 parts of amyl acetate, and completely clarify the zapon varnish by allowing it to settle for some weeks. Zapon varnish is manufactured under patents by a well-known firm in England.

Putting New Stem in Dinghey.—If a dinghey is of good design and has been properly built, a new stem can be added without disturbing the fastenings of the planks, provided the stem breast is correct. First unfasten the iron band which runs down the front of the stem and along the keel and lay it aside. Before removing the present stem, make a mould to fit it from a broad piece of thin wood, carrying this well down to the keel in case it may be necessary to cut a new check there. Examine the front edge of the stem



Putting New Stem in Dinghey.

and find the positions of the rivets that fix it to the breast; possibly it may be screwed from the inside, or fastened with bolts driven from the inside. In any case cut the wood carefully from the fastenings bit by bit till the old stem is removed, leaving the planks fixed to the breast and dead-wood. If the stem has been fitted to the keel with a dovetail joint, which requires to be slipped in from the side, the joint must be made into a simple half-check which will fit from below as in the accompanying illustration. An oak bend for the new stem must be obtained from a dealer in home-grown wood; using the mould, select a piece of wood that has grown to as nearly the correct bend as possible. Mark off the stem S from the mould, making it of the same breadth as the old one, and get it cut with the band saw; then fit it carefully into position. Give the joint a coat of thick white lead paint, and fix the scarf at the keel K with two strong brass screws, and put two rivets of ½-in. copper rod through stem and dead-wood D. Three strong brass or tinned-iron screws will hold the stem to the breast B. Trim off the front edge of the stem to the original shape, and refix the iron band.

Cementing Tortoiseshell.—For mending tortoiseshell articles, make a cement by baking a small quantity of Canada balsam in the oven until, when allowed to become cold, it is quite hard. Now melt it by the aid of gentle heat, and in it dip the parts of the article to be joined, and bind them with wire until the next day; then remove the wire and shave off the excess of Canada balsam with a sharp penknife.

Carpet Soap.—Ox-gall soap for cleaning carpets may be made in the following manner. Fifty pounds of soap is cut up into shavings and put into a pan together with 1 gal. of water; this is gently heated, stirring all the while, until a paste is obtained, and to this is added, constantly stirring, 2½ lb. of ox-gall and 2 lb. of mirbane, the last being intended to mask the odour of the ox-gall.

Painting Steel Girders.—The following is a method of preventing the corrosion of iron and steel girders exposed to the weather. First give the girders two coats of red lead mixed with boiled linseed oil. Then mix to a proper consistency pure zinc white 7lb., boiled linseed oil 1 pint, thin down with American turpentine, and give the girders three coats, following with a coat of pale hard oak varnish. For iron and steel girders under cover it has been found by experiment that red lead is a far better preservative than either red oxide or zinc white; alone, red lead also adheres firmly to the steel, and does not crack and shell off as ordinary paints do. Give the girders, therefore, one coat of red lead, mixed in boiled oil; when absolutely dry, follow with three coats of pure zinc oxide, thinned down with pale elastic oak varnish. The varnish will protect the paint against the yellowing influence of the atmosphere, and if pale will not of itself cause the paint to look yellow.

Washing Paint and Varnish Brushes.—All brushes should be washed in benzine or turpentine and shaken dry—not whipped—when it is desired to change from one colour to another or from one varnish to another. If these simple rules are followed, brushes will be found to last longer, and the painting will turn out much better than it would otherwise.

Sailing Canoe.—Fig. 1 is the long section of a sailing canoe 13 ft. by 4 ft. beam, centre-board 18 in. by 12 in. deep. Fig. 2 shows it fitted with a well, with seat all round, and centre-board. It can accommodate three

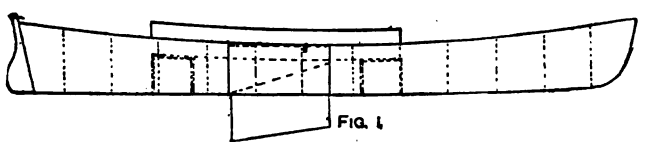


FIG. 1.

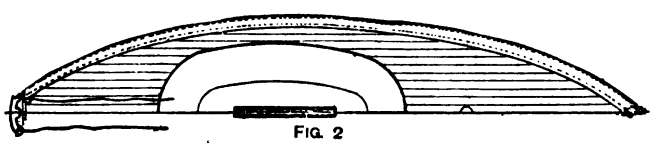


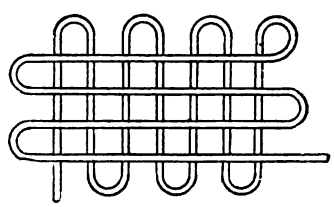
FIG. 2

Sailing Canoe.

persons easily, and with everything complete will draw about 5 in., leaving 7 in. freeboard. There is a coaming round the well 4 in. by 4 in. The canoe is flat-bottomed, and is fitted with a mast situated 2 ft. 9 in. forward of midships. The total sail area is 70 sq. ft., the fore sail having 12 sq. ft., and the mainsail area 58 sq. ft.

Dyeing Wood Veneers in Fancy Colours. — In dyeing wood veneer any colour, should only a small quantity of each stain be required, use a well-known brand, such as Stephen's or Judson's, because then a second supply if required can be relied upon to match the first. Commercially, wood veneers are handled in large quantities, in some cases being in the dye bath for several days; the solution should be kept at nearly boiling heat by means of a steam jet. A vast range of colours may be gained by the use of dye woods such as madder, fustic, logwood, camwood, Brazil wood, and red sanders; metallic salts also play a useful part. Aniline dyes are effective, but are apt to fade if long exposed to strong sunlight, but mixing the dyes in strong malt vinegar instead of water is generally regarded as a safeguard against this risk. Any of the light-coloured woods, as chestnut, sycamore, poplar, holly, and canary wood, take stains readily; satin wood, owing to its greasy nature, requires special treatment, or the dyes should be extra strong or of an acid nature. The vegetable dye woods often are used in conjunction with alum, pearlash, soap lees, or cream of tartar; salts of tin also have the effect of intensifying some colours. Knowledge of the exact proportions of dye woods, aniline dyes, and mordants to be used is best gained by a series of experiments. The essential part of effective staining is the fixing of the body colour with the fibres of the wood; this is best effected by chemical action after the stain has permeated the wood fibres; thus, on some kinds of woods extract of logwood and copperas will yield a dirty brown colour, which, by being brushed over with acetate of iron, made by steeping rusty iron in vinegar, is turned into an intense black. Similarly, on most reds the acetate, sulphate, and oxide of tin are frequently used as mordants and heighteners of colour. The following process has been patented in Germany by A. Thimm, of Berlin. The wood is covered with solutions of metallic salts by means of a brush or otherwise, and is then left to dry for about twelve hours. It is then taken into an airtight room in which gases or vapours are introduced, such as sulphuret of hydrogen, liquid ammonia, etc., according to the tint required. By using sulphuret of hydrogen with sulphide of bismuth, formed from nitrate of bismuth, brown results. The sulphide of cadmium, formed from solutions of cadmium sulphate, produces yellow. Bisulphide of tin, obtained from solutions of chloride of tin, gives gold yellow. Sulphide of lead, got from solutions of acetate of lead, results in iron grey to brown; oxide of chromium, from solutions of chromic acid, leaves green; and trisulphide of antimony, from antimony solutions, gives red. This process is said to be cheap, and the wood can be coloured to any design, the tints not being affected by air, light, or water, but can be washed. From the foregoing it will be seen that by a skilful combination of metallic salts, etc., an effect somewhat similar to ammonia on the tannic acid of oak is gained, which is well known to give shades ranging from light olive to a dark brown. Pear-tree wood is a most useful wood for all-round purposes of dyeing, and more especially for black work.

Bending Copper Tube.—It will be almost impossible to bend copper tube, unless it is fairly thick, to the shape here illustrated without slightly flattening the sides. The best plan would be to thoroughly anneal the pipe first and, when cold, charge it with lead. It should now bend readily, the bends being made on pegs



Bending Copper Tube.

of wood rounded to the diameter of the tube and to the diameter of the bend required. When the coil is finished it must be again heated, and by twisting and turning about while hot according to the convolutions of the bend, the lead may be quickly run out again, leaving the tube quite free. The parallel lines of the tube are 1 in. apart.

Carbon Paper.—Small quantities of carbon paper may be made by rubbing into unsized paper a mixture of 6 parts of lard, 1 part of beeswax, and sufficient lampblack to give the mixture the proper colour. Commercially, carbon paper probably is made by passing a long roll of paper through a bath of melted paraffin wax with which the other ingredients have been mixed. (See also Series I., p. 73.)

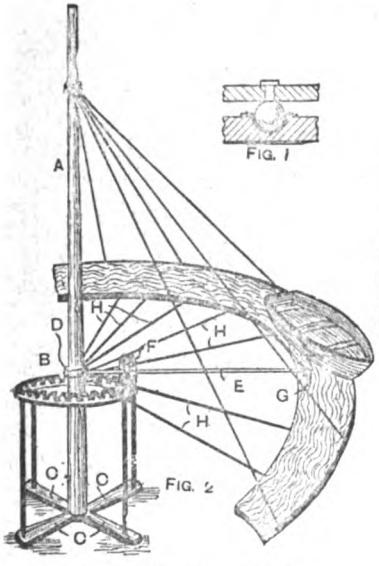
Bedding Tiles on Cement Rendering.—The best material in which to bed tiles on a cement rendered wall is a mixture of 1 part of cement and 3 parts of sand. Soak the tiles in water for at least an hour before they are used, and the rendering should be well hacked and thoroughly wetted before the bedding is commenced (a flat whitewash brush is the best tool to use for wetting). The pointing should be done as the work proceeds; the cement and sand as used for bedding should be used for pointing.

Testing Gold and Silver.—With a touchstone and nitric acid, test pieces of hall-marked gold are used for the comparison of their respective purities. The test piece is first rubbed on the stone, then the piece to be tested is rubbed on by its side. The acid is then applied to both. If both are equal in quality, they will stand equally under the acid. If one is inferior, the inferior one will disappear first. Silver can be tested in the same way. Nitric acid will turn base metals green, but silver keeps a grey colour. (See also Series I., p. 124.)

Care of Varnish Brushes.—Varnish brushes should be kept at rest in turpentine and varnish or, better still, in some of the varnish with which the brush is to be used. They should not be kept in turpentine only, because this roughens the bristles.

Setting Paint Brush Bristles.—For the first two or three days new paint brushes require special care while at rest. They should be dipped in raw oil or the paint itself and smoothed out carefully, then laid on their sides overnight. The chisel-pointed brushes should be set at an incline, the handle supported just enough to allow the brush to lie along the point. This is done to prevent twisting of the bristles, and to keep the shape of the brush perfect. It is necessary to do this only two or three times before the shape becomes "set."

A Boat Merry-go-round.—A merry-go-round or roundabout is to be constructed to take four 7-ft. boats instead of the usual hobby horses. Make the plane or water circle first. It should be made in sections bolted together, and may be covered all over or only about 3 ft. from each end of the boats. The surface on which the boats rest should be painted to represent water in motion; the sections should be joined between each boat. In the centre of each boat, through the keel, a bolt of not less than 1 in. in diameter is fixed into a ball of iron or hard wood working in a cup, as Fig. 1, thus allowing the boat to roll when in action. The centre pole A (Fig. 2) and the four feet C must be very strong;

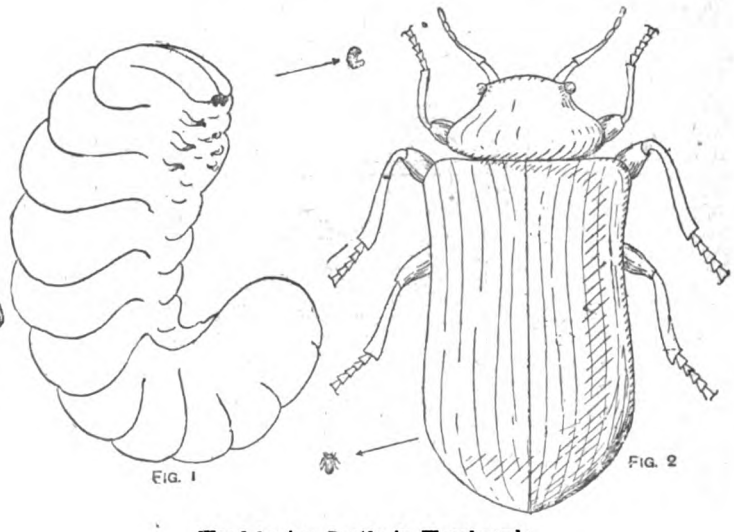


A Boat Merry-go-round.

the feet should be, say, 8 in. wide by 4 in. deep, and bedded firmly into the ground. The wheel plate B is a fixture supported on the uprights. D is a stout iron ring working round the post. From this to each boat is a connecting rod E, to which is attached a small cog-wheel F revolving on the wheel plate. Attached to the other end of the connecting rod E is a crank G with a short connecting rod working on a pivot in the sides and centre of the boat. This rod should be made of flat pliable steel. The length of the crank and rod must be regulated according to the roll of the boat. The motive power may be obtained by boys running round and pushing at the connecting rods H. Each boat will hold two persons.

Glass-bending Kiln.—For bending plate glass the best form of furnace is the regenerative system of Sir W. Siemens. The fuel is coal slack, and it is fired in furnaces that are placed at some distance from the kilns; as the hot gas is produced it is conveyed by a pipe to heating chambers below the kilns. In passing through these heating chambers, which are filled with loose bricks, the hot gas takes up some of the heat and hence arrives in the kiln at a moderately high temperature, and therefore gives great heating power. Air is admitted through ports below the bed, the gas and air meeting just as they reach the bed. The admission of air and gas is under perfect control, and any kind of flame, oxidising or reducing, may be produced at will. For bending plate glass, the quantity of gas and air admitted would only be small because a very high temperature is not needed. The great advantage of this system over an ordinary kiln is the production of a smokeless flame. One gas generator can supply several kilns with gas, and the kilns are worked alternately from left to right; that is, gas passes up through the regenerator or heating chamber on the left side, meets the air, and burns in the kiln, hot gases pass through the kiln, then down through the regenerator on the right side, heating it up and then passing to the chimney. After a certain period the gas is passed in the opposite direction. The object of this is to utilise the waste heat as much as possible.

Wood-boring Beetles in Floorboards.—Worm-eaten woodwork may be rotten and spongy, and perforated through and through in all directions with tiny holes, which vary in size from the finest needle-point to a bore of $\frac{1}{8}$ in. Large holes and small holes are mixed together indiscriminately, and freely intersect each other. Woodwork often is infested with the larvæ of one of the most destructive of the wood-boring beetles (*Anobium paniceum*), and the best and the only effective remedy will be to remove and burn all the boards that show even the slightest trace of the beetles' presence. The joists should be thoroughly treated with a solution of corrosive sublimate or, as corrosive sublimate is a poisonous substance, with commercial hydrogen peroxide; the latter has been very highly recommended. New wood to replace the old should also be treated with the preservative solution. In the illustration the beetle and its larva are shown life-size and also very much magnified (see Figs. 1 and 2). The beetle has a great liking for woodwork in the vicinity of which flour, bran, nuts, almonds, and similar commodities are stored. The beetle is difficult to get rid of when it has once got a firm hold in a locality. Flour mills and barns are especially liable to its ravages. (See also Series I., pp. 120 and 301.)



Wood-boring Beetle in Floorboards.

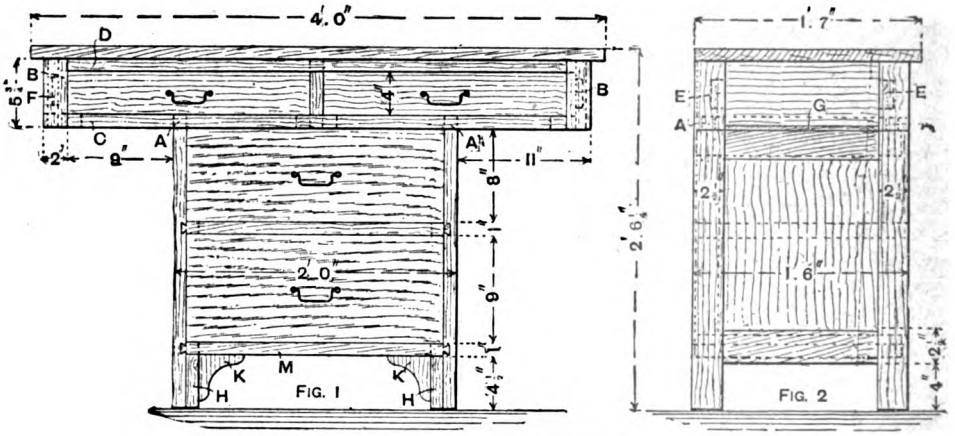
Fossil Meal.—Fossil meal, a natural product found in many parts of the world, consists largely of siliceous skeletons of minute animalculæ; in Germany it is called "berg mahl," or mountain meal, and also kieselguhr. Tripoli powder is a variety of fossil meal. Kieselguhr is used in the production of non-conducting coatings, as an absorbent for nitro-glycerine forming dynamite, and also as a filtering material. For coating steam pipes the fossil meal should be mixed with about 10 per cent. of fireclay, then made into a paste with water and laid on the pipes to a thickness of about 1 in. and bound up with any coarse material cut into strips and wound on spirally.

Lubricants for Drilling Steel and Iron.—A lubricant for drilling steel beams by hand is made in the following way. Take equal parts of tallow and soft soap and boil together until the ingredients are thoroughly incorporated, stirring constantly. This lubricant will be found very superior to oils generally used, and will keep the drill cooler, while costing much less. This is used by members of the Holeborers' Society in the shipyards. For drilling steel castings, mix twopennyworth of glycerine with a quart of naphtha. If a lubricant is used on cast-iron the drill will not bite, so cast-iron is bored dry.

Fixing Mail-cart Tyres to Rims.—Below is described how to fix tyres to the rims of mail-carts and perambulators. If the cement (a mixture of gutta-percha and pitch) cannot be brought to a liquid mass, use it like a stick of sealing wax; smear it all round the concavity of the rim, then arrange a device for spinning the wheel on its own bearings with a gas jet playing on each side of the rim. This will not injure stove enamel or nickel plate if care is taken to keep the rim rotating, and the deposit will be thoroughly melted. When this is done, remove the wheel quickly and apply the tyre, working it into position so that it will be fixed with the cooling of the wheel.

Cleaning Varnished Woodwork.—Wash all smoky and dirty varnished woodwork with benzoline; two hours afterwards, size with a solution consisting of ½ oz. of glue and ½ oz. of fuller's-earth dissolved in 6 pt. of water. A day should be allowed to elapse before applying the varnish.

Combination Table and Drawers.—The piece of furniture shown by Figs. 1 and 2 was designed to stand in front of a window and serve the purpose of a table and a chest of drawers. It is in two parts, the top and two top drawers being fixed to the lower part by tenons A. The corner pieces B are of 2½-in. by 2-in. stuff, and the pieces C and D (Fig. 1) are fixed to them by dovetail joints. The back is similar. The ends are



Combination Table and Drawers.

tenoned into the blocks E (Fig. 2), the length of the tenon being half the thickness of the wood F (Fig. 1). G (Fig. 2) is a piece of ½-in. moulding. The ends of the lower part are panelled, and a block H (Fig. 1), 2½ in. by 1 in., is glued to each foot, and a corner-piece K fitted. If the rail M is secured to H it will not need tenoning to the upright.

Stitching Fronts and Tops of Louis Heels.—The fronts and tops of Louis heels of boots must be sewn with a fine awl and white thread having fine bristles on each end. For attaching bristles to thread see Series I., p. 104. The portion of the sole that is to form the breast of the heel must be split while it is mellow—that is, when it is just dry enough to be workable. This is done with a sharp knife by separating the grain from the true skin, which is afterwards skived quite thin. It is then pinned up the front either before or after the sole is stitched (afterwards is preferable), and, in the case of pumps, after the shoe is second-lasted and while the heel is kept firm by the long wood heel tack. Much depends on the fitting of the wood and on getting the rand on clean with a clear, sharp edge where the stitches are to be set. As a guide for the stitches, a suitable wheel can be run round to leave a tracing, and a portion of the skived sole should come up under the top piece to give a nice finish to the breast with more solidity when the grain is stuck up and turned over. For the thread, use good white flax or No. 9—about three strands of the latter should be used or four of the former. The thread must be wetted and twisted, but not so much as for ordinary stitching. It must not be long, as it must always be pulled through with one pull—that is to say, when the bristles are through, the thread is pulled through and the stitch set in place all in one sweep. Every stitch must be set in the same way—that is, thrown over the thread that is out on the right-hand side, so that each one forms a small bead. In some cases silk twist is used for stitching, but this is not only more difficult to use at first, but it gets dirty quickly and is not so easy to clean as thread, and in pricking up it is put in place with more difficulty should a stitch be slightly out of truth. A large peg awl, sharpened like a screwdriver, but with one bevel longer than the other, will make a good prick-stitch. Weak gum is used for cleaning the stitches, whilst a cement made with acetic acid and gelatine is used for sticking the breast of the heel.

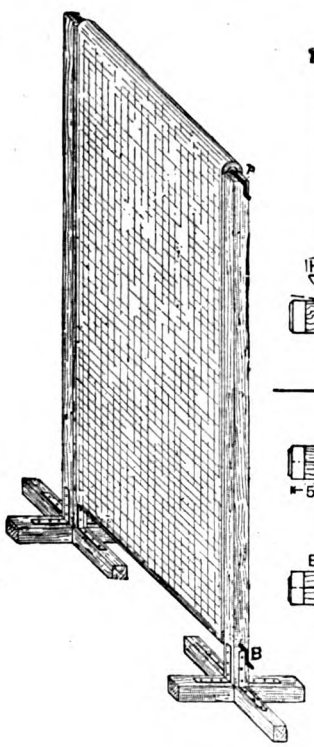
Cold-process Hard White Soap.—Soap made by the cold process is not equal with regard to quality as that which is made by boiling, because it contains all the impurities from the alkali and the fat, and also the glycerine formed from the fat, and is usually alkaline because of the excess of caustic soda present. To make the soap in large quantities, it will be necessary to have a large pan or vat in which the fat can be melted and afterwards mixed with the lye, a smaller pan for the alkali, a large can or jack for lye, a mixing arrangement or "crutcher," and soap frames or moulds. Tallow and cocoanut oil may be employed; also other oils, such as cotton-seed oil, etc., but not in great quantity. Best caustic soda must be used, and it should be dissolved in sufficient water to produce a lye of 66° Tw. (sp. gr. 1·33). One hundred parts of fat require for complete saponification 15½ parts of 70-per-cent. caustic soda, or 60 parts of a lye of 66° Tw. The fat must be heated in the pan to a temperature of 110° to 120° F., and the lye to 80° F. The lye is then poured slowly into the fat and is crutched in immediately; the crutching should be continued for some time after all the lye is in, and the soap then run into the frames, in which it is kept at 70° F. for two or three days until the soap is fully formed and set.

Washing Soda and Carbonate of Soda.—Carbonate of soda mentioned in recipes and formulæ is pure dry carbonate of soda (Na_2CO_3), unless otherwise stated. Washing soda is carbonate of soda, but it also contains much water of crystallisation, its formula being $Na_2CO_3 10H_2O$. One hundred parts of washing soda contain 37 parts of carbonate of soda and 63 parts of water. Thirty-seven parts of dry carbonate of soda are therefore equal in their effect to 100 parts of washing soda. If this fact be borne in mind, then either dry carbonate of soda or washing soda may be used in any preparation provided the proper proportions are worked out.

Bending Keel of Canoe Yawl.—Either of the following methods of bending the wood can be tried, but undoubtedly steaming makes the best job of bending to shape the keel of a canoe yawl. Secure the keel on the keel plank in the correct position for building, drive a wedge in at the fore part to the height required for sheer, then shore down aft of this from above to the necessary curve, and secure in place by means of clamps; the same operation reversed is performed at the after end of the keel. The other method is to put two saw kerfs in the keel lengthwise for a sufficient distance, then bend each piece separately round to the required curve and secure together by means of bolts; the same is repeated at the other end of the keel.

Dissolving and Moulding Celluloid.—To dissolve scrap celluloid, place the celluloid in a closed canister and moisten it with camphorated spirit. If desired, a large piece of camphor and some methylated spirit may be used instead of the camphorated spirit. When the celluloid is softened, it should be thoroughly kneaded to render the whole mass uniform. The moulds should be made of brass or iron polished inside; it is the polished surface that produces the gloss on the articles. Plaster moulds are quite porous, and, being rough on the surface, will produce articles with a similar surface. If plaster moulds are used, they must be saturated with linseed oil or glue size to take away the porosity. But the best result will be obtained by using brass or iron.

Frame for Photographic Background.—A photographic paper background, 6 ft. square, must be mounted on canvas say 12 ft. long, and attached at each end to rollers, which rollers pass through sockets; then, by means of the handles A and B, with which the rollers are provided, the background may be wound up or down as required. Of course, the rollers must not run too freely.



Frame for Photographic Background.

When out of use the rollers are lifted out, and the apparatus may be stored in a comparatively small space. The arrangement has given satisfaction in practice.

Cassel Earth.—Cassel earth is an earthy pigment resembling the umbers in its composition and properties, obtained in various tints and shades. The earth is found in thin layers among rocks in various parts of Germany. As a pigment cassel earth is not to be depended upon; the colour is not permanent, and the earth varies in composition; therefore it is very little used as a graining colour.

Re-grinding Plug Cocks.—In repairing plug cocks, gland and screw-bottom, by grinding in by the hand method, the key should be taken out and thinly coated with moistened red ochre, then placed in the barrel and slightly turned. This will show the parts that are raised; these parts should be filed down with a fine float. When the key or plug bears all round it can be ground in by using a little very fine emery powder and sweet oil, the head of the key being held in a vice and the body turned by hand. The emery then is wiped off. If the key bottoms in the barrel of a gland cock the key should be filed shorter, and if it passes through the barrel of a screw-bottom cock the key may be shortened and the thread cut longer. A new and thicker bottom washer must be obtained; this washer must be truly and carefully made and fitted. Special skill and judgment are required to regrind a cock, which may be entirely spoilt by an unskilful workman.

Colliery Tub or Truck.—For a colliery tub to hold about 8 cwt. for use underground on a 22-in. gauge, first prepare two pieces of oak scantling 5 ft. 4 in. long by 4 in. by 2 in., and three pieces 1 ft. 8 in. by 4 in. by 2 in. Plane up and frame together as shown in Fig. 1, making double tenons on the ends of the cross timbers, as shown in Fig. 2. Next get out four pieces 2 ft. 4 in. by 4 in. by 1¼ in. for the diagonals A (Fig. 1); take care that the frame is square, then place the diagonals on top of the frame and mark the angles of the shoulders, then tenon and mortise them in the positions shown (Fig. 1), when the joints can be painted and the frame knocked together. Now prepare four pieces of oak 5 in. by 4 in.

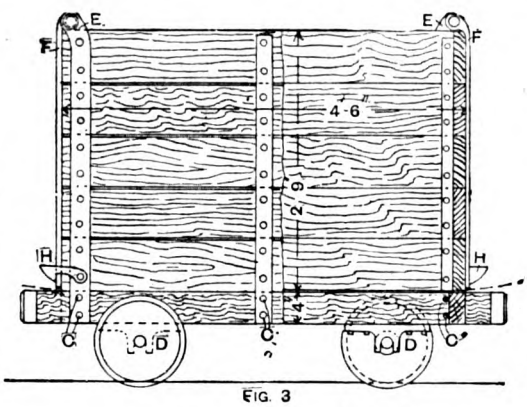
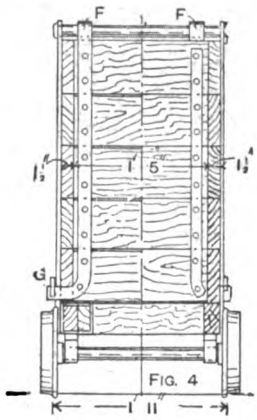


FIG. 3



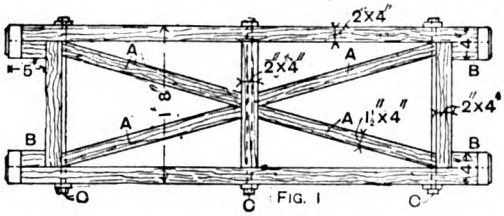


FIG. 2

Colliery Tub or Truck.

by 2 in. for the buffers, and screw them to the ends of the sole bars at B (Fig. 1), using square hoops made of 1½-in. by ¼-in. iron let flush on the ends to prevent splitting. Bore holes through the frame for ⅝-in. tie-bolts C C (Figs. 1 and 3). Screw an iron plate 4 ft. 4 in. by 1 ft. 6 in. by ⅜ in. on the frame to form a floor, and bolt on the pedestals D (Fig. 3) with centres 15 in. from the ends of the buffers. These may be of cast- or wrought-iron, and should simply drop over the axle. Next prepare four corner irons E (Fig. 3) of 2½-in. by ¼-in. iron, or preferably 2½-in. by 1¼-in. by ⅜-in. angle steel, drilling ⅝-in. holes for the tie-bolts C, ½-in. holes for the side-board bolts, and 1½-in. holes at the top for the hinge pins. Bolt these on. also a 2-in. by ¼-in. plate in the centre, and board up with 1½-in. deal, using washer-plates under the heads of the bolts inside. Now prepare ten deal boards 1 ft. 5 in. by 1½ in. for the ends, as shown in Fig. 4; place the hinge straps F (Figs. 3 and 4) in position, and bolt to the boards, using washer plates inside as shown on the left of Fig. 4. The hinge straps may be made of 2-in. by ½-in. iron, with a forged eye at the top to hang on the pin and the ends turned at right angles, as at G, for the catches H (Fig. 3) to drop over, and also to serve as handles for lifting the ends when unloading the tubs. The wheels are of cast-iron 10 in. diameter on the tread, keyed on to 1½-in. axles as shown in Figs. 3 and 4. In the illustrations, Fig. 1 shows the under-frame for the tub; Fig. 2 is a double tenon for the joints; Fig. 3 is a side elevation (left hand) and a section (right hand) of the tub; Fig. 4 is an end elevation (left hand) and a cross section (right hand) of the tub.

Fish Glue.—Fish glue is made by boiling with water the refuse, that is the skins, bones, etc., of the fish-curing establishments until it becomes broken down into material that is largely soluble in water; the fluid is strained and then evaporated. Fish glue, owing to the impurities it contains, usually remains fluid, but it is sometimes produced in the solid condition, and then appears somewhat like ordinary glue. It always has a decided fishy odour. Isinglass is a fine glue or gelatine prepared from the "sounds" or swimming bladders of the sturgeon, the shark family, hake, and similar fish.

Bamboo Paper-rack.—A design for a bamboo rack with three divisions to hold sheet music and newspapers is shown by Fig. 1. The rack is made of ¼-in. or thinner bamboo. A useful size would be 15 in. high by 15 in. long, the divisions being 3 in. apart, and the four uprights or legs slightly bent outwards both at the top and bottom. Fig. 2 is an end view of the rack; the two divisions are

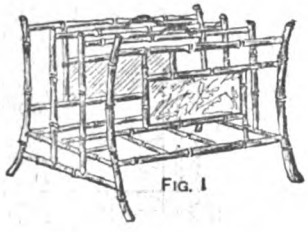


FIG. 1

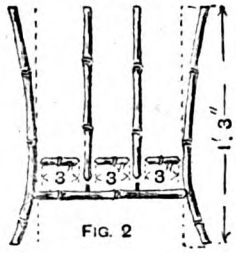


FIG. 2

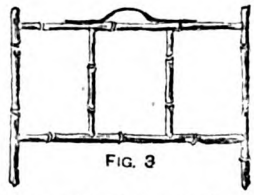


FIG. 3

Bamboo Paper-rack.

dowelled into the lower traverse, whilst the upper division forms part of the bottom for the rack, being in a line with the bottom traverse of the sides. Fig. 3 shows one of the two partitions, and on the top traverse is a piece either of black or white beading-cane to form a handle. There are also two cross traverses dowelled into the bottom traverses of the sides to form the bottom of the rack. The sides are filled in as shown by Fig. 1, the centre panel consisting of a piece of lacquer fixed into the bamboo framework with split beading-cane.

Coloured Carbon Papers.—For yellow carbon paper, melt 1 part of cerasin and stir in 5 parts of castor oil, then mix thoroughly with 10 parts of chrome yellow, and, after removing from any open light, add 10 parts of petroleum ether. While it is warm apply as evenly and as sparingly as possible to moderately thin paper, removing the excess with a little blotting paper. For green carbon paper, use Brunswick green in place of chrome yellow.

Sewing Machine Missing Stitches.—When a Howe sewing machine of old pattern misses stitches the fault may be either in the machine itself or in the needles. If in the machine, either it is out of time or the shuttle has got worn out or it has become blunted. If the needles are right and are fixed according to the mark in the needle bar, the needle should be in such a position that if the machine is stopped when the point of the shuttle is exactly opposite the needle, then the eye of the needle should be about ¼ in. below the shuttle point. If the time of the machine is correct, the needle should be at its lowest point when the shuttle is as far back as it will travel, and both needle and shuttle should move almost simultaneously, the needle leading slightly. The needle should be as close to the shuttle as possible without touching, and the time of the machine is altered by moving the large cams on the shaft underneath the machine.

Perspective Drawing of Bevel Wheel.—In obtaining a perspective drawing of a bevel cog or toothed wheel, first draw an elevation (Fig. 1) and plan (Fig. 2) of the wheel, then inscribe a polygon with a number of sides corresponding to that of the teeth on the edges, as at A to G and H to M (Fig. 2). This will resolve the problem into that of drawing a polygonal pyramid containing the outer faces of the teeth and another inside the first and containing the faces at the bottom of the

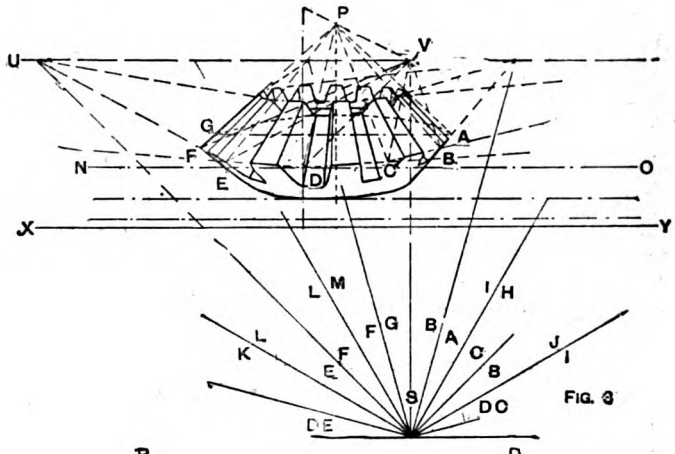


FIG. 3

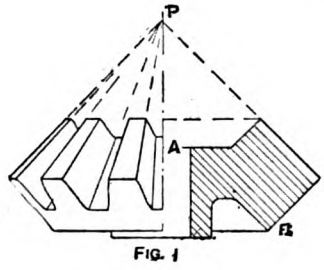


FIG. 1

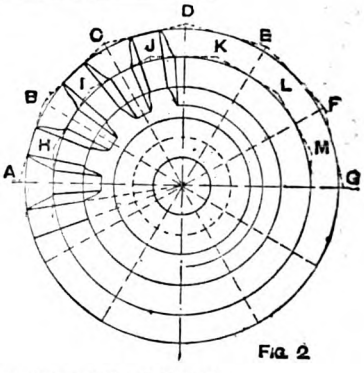


FIG. 2

Perspective Drawing of Bevel Wheel.

teeth. Suppose that point D is in the picture plane on the left of the spectator and that S (Fig. 3) is the station point, U V the horizontal line, and X Y the intersecting line of picture plane. Draw the intersecting line N O of the plane of the largest polygon, then draw the vanishing parallels D E, D C, E F, C B, F G, B A (Fig. 3) at angles corresponding with those on Fig. 2; this will give the vanishing points. Find the corresponding measuring points, and with the aid of these draw the polygon in perspective A B C D E F G (Fig. 3), dividing each line into three parts, the centre one of which will be an edge of a tooth. Now find the perspective position of point P (Figs. 1 and 3), which will be the vanishing point of all the edge lines of the teeth. To this point join the centre divisions of each of the polygon sides, then draw a smaller polygon containing the top edges of the teeth. Now draw vanishing parallels K L, J I, L M, and I H (Fig. 3) corresponding with the angles of the polygon H I J K L M (Fig. 2), and draw this in perspective in a similar manner to the larger polygon; then by joining the points the teeth may be shown. Now put in the two circles shown by the lines A and B (Fig. 1) to complete the drawing. Most of the construction lines are omitted in Fig. 3.

Horse Gear for Driving Circular Saw.—Fig. 1 shows the machinery for driving a circular saw that is to be worked by one or two horses at the end of an 11-ft. pole. The toothed-wheel T and the pinion P are 5 ft. and 6 in. in diameter respectively. The vertical shaft L, to which the tooth-wheel is keyed, is turned by two horses connected to the end of the arm A. This arm should be about 11 ft. long. The lower end of the shaft L works in an iron socket. This shaft is secured by three iron stays S; two only are shown in Fig. 1. Fig. 2 explains the construction of the stays. Through the centre hole is passed the vertical shaft, above which the driving arm A (Fig. 1) is secured to the head of the shaft, a cotter being passed through a cotter-way in the eye of the arm and the shaft. The stays S are secured to the foundation, bolts being passed through the holes, and nuts firmly screwed down on the feet of the stays. These stays do away with the old-fashioned overhead beam. On the farther end of the horizontal shaft H (Fig. 1) is keyed a wheel W, 5 ft. in diameter, from which a belt leads to the pulleys on the saw-spindle. Two bearings at least will be required for this shaft to run in. They should be close to the pinion and belt-wheel, as indicated by the letters B. If desired, a third bearing could also be placed at the centre of this shaft. Fig. 3

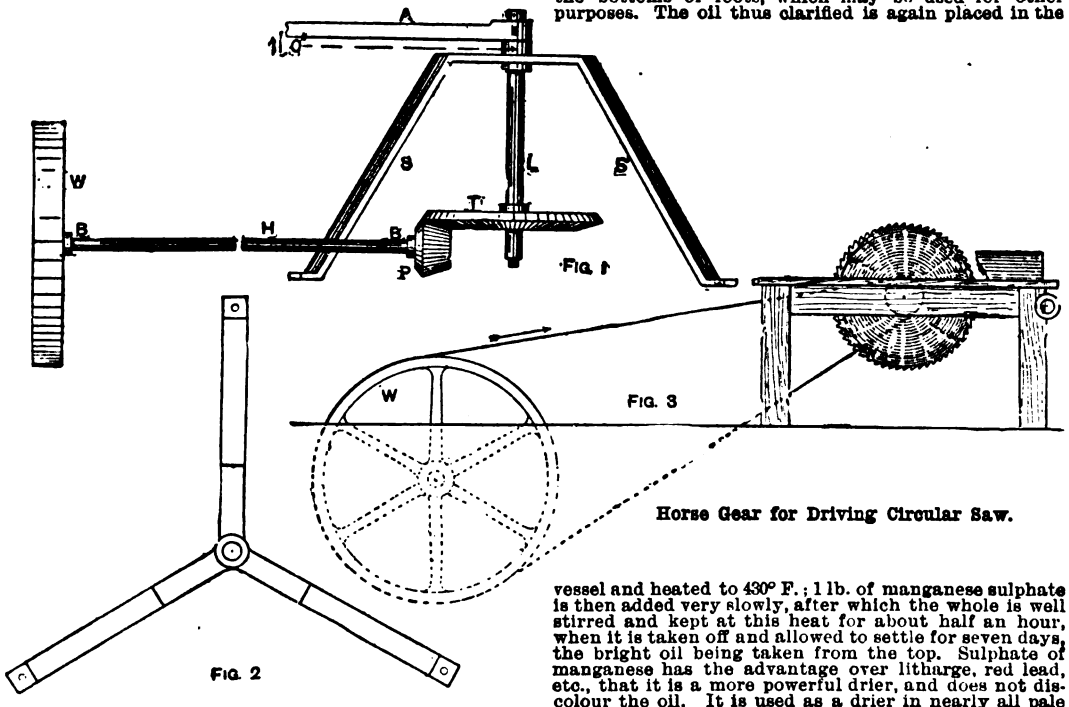


FIG. 1

FIG. 3

FIG. 2

Horse Gear for Driving Circular Saw.

is a side view of the saw-bench, with the belt-wheel W. As will be seen, the greater portion of the belt-wheel, and consequently the horizontal shaft, is below the floor, thus allowing a free passage for the horses when making their circuit. A wooden case, in the form of a launder, protects the shaft. The pulleys on the saw-spindle may be 6 in. or 7 in. in diameter, and the bench 4 ft. by 2 ft.; a saw 20 in. or 22 in. in diameter will be quite large enough, driven in the manner described. Should there be a tendency of the belt to slip, cross it, and drive the horses in the opposite direction. When sawing, be careful not to over-feed the timber. With wheels of the size stated above the circular saw should make about one hundred revolutions to every one revolution made by the large toothed wheel at T, illustrated in Fig. 1.

Strength of Water Pipes.—The strength of pipes and tubes of all kinds depends upon the tensile strength of the metals the pipes are made of; this strength can only be ascertained by experiment or trial. Most calculations are based upon the tensile strength of bars and sheets of the metals as found by experiment. All the published tables of tensile strength vary very much, and that this must be so is evident to all who have to deal with metals, and know how much they differ in their physical properties. The safe strength of lead is about 475 lb., cast-iron 3,600 lb., wrought-iron 10,400 lb., and copper 3,600 lb. per sq. in., and these weights can be used in pipe calculations. In pipe problems the normal water pressure should not be used, and an allowance for shock should be provided. An easy rule for finding the proper thickness of the sides of pipes is $T = \frac{R \times P \times E}{S}$, in which T = thickness of pipe in inches; R = radius of pipe in inches; P = pressure of water in pounds per square inch; E = an allowance for excessive strain by shock; and S = safe strength of the metal in pounds per square inch. To work an example, a 6-in. cast-iron pipe is charged with water under a dead pressure of 100 lb. per square inch, but shock sometimes increases the pressure four times. Then the thickness of the sides of the pipe is worked out as follows. $T = \frac{3 \times 100 \times 4}{3600} = \frac{1}{3}$ in.

Drying Oil for Varnish.—To prepare from raw linseed oil a good pale drying oil such as is used in varnish making, place in a vessel 3 gal. of pale linseed oil and heat to 400° F.; keep at this heat for four hours, constantly stirring. Remove the oil from the fire and allow it to cool, then take the top portion, say about 2½ gal., leaving the bottoms or foots, which may be used for other purposes. The oil thus clarified is again placed in the vessel and heated to 430° F.; 1 lb. of manganese sulphate is then added very slowly, after which the whole is well stirred and kept at this heat for about half an hour, when it is taken off and allowed to settle for seven days, the bright oil being taken from the top. Sulphate of manganese has the advantage over litharge, red lead, etc., that it is a more powerful drier, and does not discolour the oil. It is used as a drier in nearly all pale elastic varnishes.

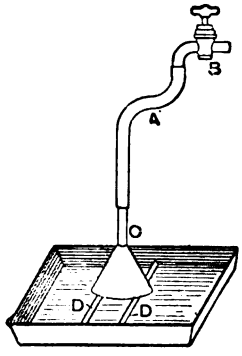
Magnetic Carbide.—Magnetic carbide is prepared by heating a mixture of equal parts of red hematite (*i.e.* native ferric oxide) and sawdust in a retort; it is therefore really a mixture of charcoal with metallic iron or magnetic oxide of iron. It might be possible to make small quantities of this magnetic carbide by heating the materials enumerated above in a small crucible in the fire.

Renovating Veneered Furniture.—If the veneer on the flat surfaces of furniture is not very badly chipped it can be repaired, but if fresh veneer has to be relaid, prepare a piece of wood as large as the damaged surface, and heat it in an oven to make a caul. Remove the old veneer, and coat both the new veneer and woodwork with thin glue sparingly applied; then secure the veneer to the work and hot wood caul with hand-screws. A piece of paper should be placed between the veneer and the hot caul, so that no glue will reach the caul, or the work will be spoilt. Repairs to veneer are best done with V-shaped pieces, making the grain agree as nearly as possible. A piece of paper glued over the repair will exclude the air and improve the joint. Scrape off all grease and dirt wherever veneer is to be applied.

Clays.—As regards the differences in appearance and in composition between porcelain clay, pipeclay, and fireclay, it may be said that porcelain clay, China clay, or kaolin is a fine white powder, perfectly smooth to the feel; pipeclay and fireclay are very similar in appearance, but grey and coarser than porcelain clay. The following analyses show their respective compositions:—

	Porcelain clay	*Pipeclay*	*Fireclay*
Silica	45·52	62·99	66·16
Alumina	40·76	20·04	22·54
Lime	2·17	0·30	1·42
Potash and Soda	1·90	—	—
Oxide of Iron	trace	trace	5·31
Water	9·61	10·70	3·14
Magnesia	—	0·94	trace
	99·96	94·97	98·57

Washing Photographic Prints.—Hand washing is the best method of treating prints; these are transferred one by one from one dish of water to another. The sketch below shows another method of washing small quantities of prints. Fix a rubber tube A to the tap B, and to the other end of the tube attach a large funnel C,

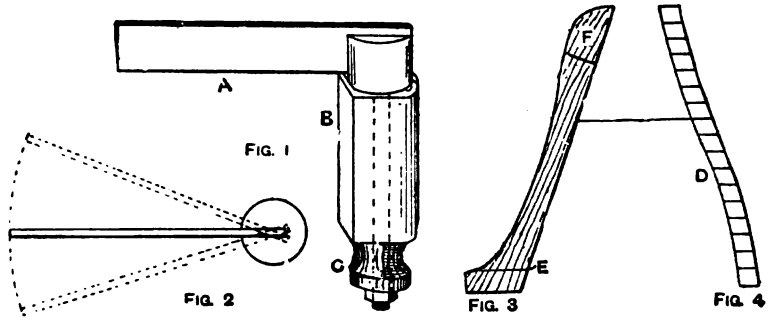


Washing Photographic Prints.

and rest the funnel upon two glass rods D. In this way the water is introduced at the bottom of the dish, and flows over the top. The funnel serves the purpose of spreading the pure water all over the bottom of the dish and forcing out the contaminated water.

Cleaning Book Covers.—To clean up calf or morocco covers of books, the following method may be employed. Procure a piece of Para rubber; if this is not soft, heat it over the fire or gas flame, for hard, square edges produce scratches on the covers. With this rub over all the gilding on the backs and sides, gently at first and a little harder afterwards; this should make the gilding clear and bright. Now prepare some paste-water, mixing flour with water till it is as thick as good milk, and apply this with a sponge. Wash over the leather, taking care not to touch the cloth or any of the gilding. To clean the cloth sides, beat up in a dish the white of an egg until it becomes a solid mass of dry-looking froth; allow this to settle into a clear amber-coloured liquid, and with this wash over the cloth. Have plenty in the sponge and work quickly in a circular motion, taking care not to go over the same part twice. For some cloths a weaker solution must be used, so add as much water as will make twice the quantity. If this glair is not properly beaten up the parts of the book to which it is applied will when dry have a nasty glaze which will turn white and so spoil the appearance. To remove scratches in morocco, if the skin is not broken, damp the part with hot water, and beat with a clothesbrush, holding it by one end and beating with the point of the other; this will raise the grain, and if the scratch is slight, it will be hidden effectively. If not, while still damp, with the point of a fine needle carefully lift the leather in the scratch, working with the grain, and afterwards damp again and use the brush. If the skin is broken use the needle and pick up all the edges of the scratch on both sides, rub in a little thin paste, and lay down the edges, using the needle so that each little piece may be carefully replaced in position. Rub off any surplus paste with the sponge. When dry go over it with the needle, stroking where necessary in the direction of the grain of the morocco leather. For calf, instead of the needle and brush use a bone folder or the handle of a tooth-brush. Damp the part first with hot water, rub on a little paste with the finger, and rub well with the folder, taking care to keep it flat or more marks will be made. Wash again and allow to dry. Repeat the operation if necessary. If the skin of calf has been broken, the method of pasting down must be employed, using the folder instead of the brush.

Using the Horizontal Square in Coach-body Making.—The horizontal square is necessary for dressing up some part or other of the framework in heavy coach-body making, and also in dressing up the sham door pillars in gigs, waggonettes, and mail phaetons. Fig. 1 shows a horizontal square; it has a blade A attached to the stock B by a long stud, indicated by dotted lines, and this has a thread at the bottom end to which is fixed a milled nut C, this nut tightening down the blade A when set at the desired angle, as shown in Fig. 2. The square is used for dressing up timber that has curves, and sails out of the vertical, or contracts from a parallel line in such a manner that when the parts in question are framed into the body they line in parallel no matter what curve or contraction there may be. To explain more fully the use of the square, a pattern of a sham door pillar is given at Fig. 3, whilst Fig. 4 is a back view, D showing the side sweep when dressed up. The lines marked across are the horizontal lines; these are obtained from a cant which should be made half the width of the body. Having faced the pillars



Using the Horizontal Square in Coach-body Making.

on the back, place the side pattern (Fig. 4) on this face, and mark off the horizontal lines; then set a bevel to the sail back of the sham door as E (Fig. 3); mark this bevel on the outside of the pillar, then place the stock of the square on the pillar as Fig. 4, throwing the blade round to the bevel of E (Fig. 3), and keeping the square on the horizontal lines from top to bottom of the pillar. At the top of the pillar F (Fig. 3) a square line is marked across from the back face to show the effect it would have if dressed up with an ordinary square. It would be almost impossible to keep the blade to the rake of the pillar by using an ordinary steel bevel. These remarks also apply to bottom-sides of broughams or any other work that has curves, the square being set to the square line of the body in all cases.

Street Piano or Piano Organ.—The piano organ gives a combination of tones produced by hammers striking steel wires and at the same time operating on valves in connection with wind-operated reeds, which thus sound in perfect chord with the piano note. The cylinders of an ordinary street piano are of solid beech, 10 in. to 12 in. in diameter, and into these are driven pins, leaving about ½ in. projecting. As the barrel is revolved these pins come in contact with a striking plate affixed to the hammer butt, bringing the hammer away from the wires with a gradual movement, then suddenly releasing them. The hammers when at rest press against a guard which keeps them lightly touching the wires; they are kept in this position by springs—one to each hammer. On the strength of these springs and the fact that each note is given out by the hammer striking five wires instead of three, as in ordinary pianos, depends their loud tone. They are not furnished with dampers, the vibrations being checked with the tip of the hammers instead. Six or eight tunes may be arranged on each cylinder, the arrangement being on similar lines to musical boxes fitted with cylinder and steel combs. A racket arrangement enables the cylinder to be moved a space corresponding to the setting of the pins.

Windmill.—Fig. 1 is an elevation and Fig. 2 a plan of the head of a windmill that is to be turned out of the wind by turning the tail. This method of turning is suitable for any design of windmill head, but probably will require modifying to suit each particular case. A is the tail and B the tail supports, fastened with a movable joint to the head C. A very good way will be to carry the iron strut D through the head, and also through holes at the end of the tail supports. The strut D is braced to the head of the mill by a rod E. The rod F is loosely pivoted at the end of the strut D, and the other end is fastened to the tail. To the head is fastened an arm, and at its end is a small pulley G; over this pulley passes a wire cord to carry the weight H, the other end of the cord being fastened to the tail. At right angles to this arm is another arm I; at the end of it is another pulley, but laid flat for the cord K to pass round. Near the centre of the head, but clear of the working parts of the mill, is a third pulley L to guide the cord down the side of the pump rod or vertical shaft. On the shaft or pump rod is a sleeve M, to which is fastened the end of the cord K.

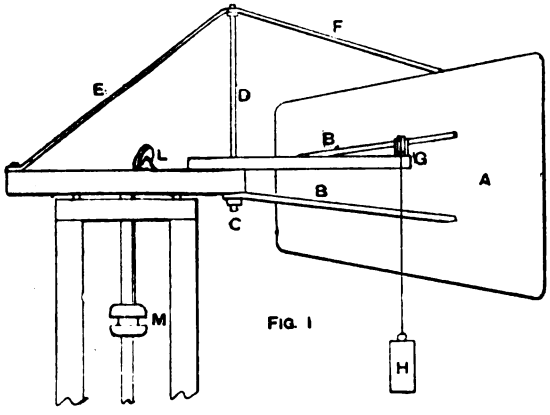


FIG. 1

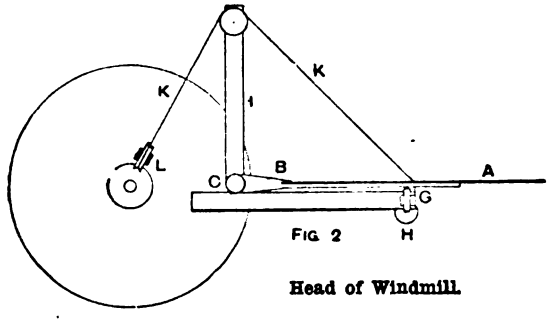


FIG. 2

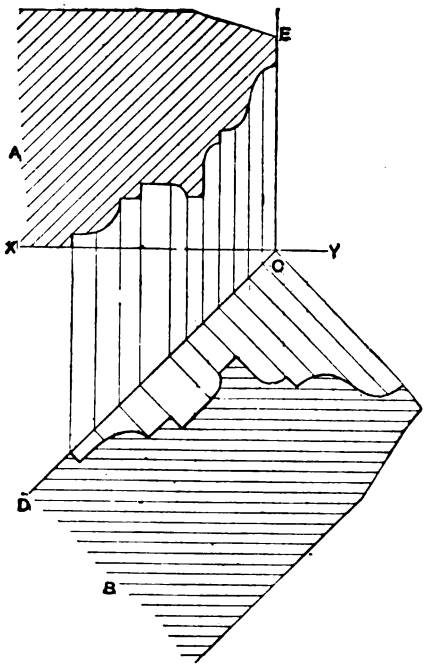
Head of Windmill.

This sleeve turns with the shaft, but is arranged to slide up and down freely. Round the sleeve is a loose ring, and attached to the latter is a cord or rod reaching to the bottom of the tower, the rod being fixed to a lever, or, if a cord is used, to a small ratchet windlass. The working of the tail can now be easily traced. In the drawings the mill is shown to the wind; by winding the cord on the windlass the tail will be turned in the same plane as the mill and at the same time the wind will turn the head; on releasing the ratchet, the weight H will again take the mill into the wind. To avoid confusion the working parts of the mill are not shown.

Covering Sink Top with Pewter.—Pewter is a harder metal than lead, and cannot be worked as lead is; neither can pewter be annealed and softened like copper. The sheet pewter should be cut to shape to fit round the bowl, the edges carefully fitted together, and then soldered and cleaned off. The solder, which should be composed of tin, lead, and bismuth in about equal proportions, should melt at a lower temperature than the pewter. (Also see p. 34.)

Ventilating Kitchen Containing Gas Stove.—A ventilating grid in the external wall of a kitchen which contains a gas cooking stove will act as an inlet ventilator only; the grid will allow fresh air to enter, but will do nothing towards extracting the gas fumes. A ventilator in the chimney breast will certainly tend to remove the gas fumes, but most probably will be only a partial remedy. If the kitchen range will bear a ventilator in the breast (and if the draught in the chimney is strong enough), then the best thing to do will be to have a tin or zinc hood or canopy made to fix over the gas cooker, and from this hood take a 4-in. pipe to the chimney, passing the pipe through the breast. This arrangement will successfully dispose of the fumes of the gas stove, but will not remove any objectionable fumes from the kitchen. If the ventilation of the kitchen is desired, then recourse must be had to the ventilator in the chimney breast; and the size of this ventilator must be as great as the successful working of the range will permit.

Cant Mould for Octagonal Cap or Base.—The illustration given below serves to indicate a method of constructing a cant mould to apply to an octagon cap or base. Set out the plan of two adjacent faces of the octagon as shown by D C E, then through C draw X Y at right angles to C E. On X Y draw the true section of the moulding as shown at A. Next draw any convenient



Cant Mould for Octagonal Cap or Base.

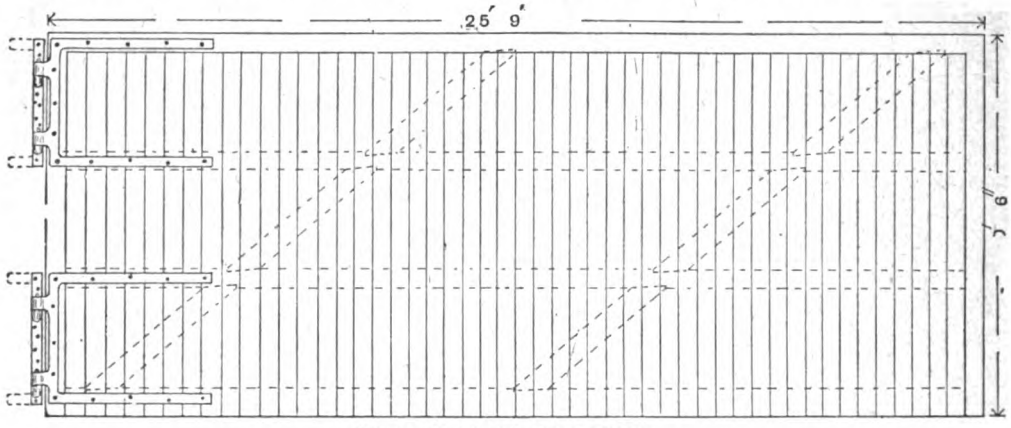
number of ordinates from the profile of the moulding, terminating them on the plan of the face C D; then from the place where these ordinates meet D C, draw the ordinates for the cant mould at right angles to D C, marking off on them the same distance from C D as the corresponding ordinates from X Y. If lines are drawn through the points thus obtained the shape of the mould required will be given as shown at B.

Temporary Filling for Engraved Work.—By the method of temporarily filling engraved or incised silver, the filling may be removed at pleasure. To prepare the engraved work, clean it with a brush and turpentine, dry, and clean up. Dissolve one stick of white sealing wax in 2 oz. of alcohol, so that it makes a thick cream, and keep corked tightly. With a small brush quickly paint in the white solution and place aside to set. When hard, clean off the surface with spirit of wine. To remove the solution from the incised work, build up round the engraving a wall of beeswax or white wax, fill the interior with spirit, and allow to stand for twenty-four hours in a warm place. The spirit will evaporate; add more as it disappears. Then pour off the spirit and brush out the solution, repeating the process till the tray is clean. Boil the incised silver for an hour in a copper containing a solution of potash, say 1 lb. to 4 gal. of water. Then rinse in clean hot water, and dry with leather while warm.

Buff Enamel Paint for Venetian Blinds.—For a light buff enamel or varnish paint for venetian blinds, mix together 8 lb. of pure zinc white ground in boiled oil, 1 oz. of Oxford ochre paint, and ½ oz. of middle chrome paint; then add ¾ gal. of hard church oak varnish and ½ pt. of japan gold size. After thoroughly mixing, add ½ pt. of American turpentine slightly warmed, when the enamel will be ready for use. A better result may be obtained by having the zinc white ground in varnish; this makes the enamel dry sharp and absolutely hard. The colouring matter may be added according to the shade required.

Efflorescence on Plastered Walls.—Efflorescence on the surface of a plastered wall that does not cause the plaster to disintegrate may be cured by covering the wall with laminated lead, which is generally applied with paste or glue, and for security is tacked along the edges with copper or rustless tacks. If the plaster is disintegrating the only cure is to hack the plaster entirely away, and apply a mixture of Portland cement and absolutely clean sharp sand in the proportion of 1 to 1.

Hinges for Large Braced Door.—A very large door (say 20 ft. to 25 ft. by 10 ft.) would be very heavy, and the leverage on single pins be great; if the ordinary form of hinges is used, the strain on a limited portion of the post becomes far too much. To overcome these difficulties



Hinges for Large Braced Door.

the strap hinges shown in the accompanying illustration have been designed; these hinges should be made of wrought-iron bar about ½ in. by 2½ in. As a further means of security, the straps of the post might be returned at each end.

Colouring Architectural Drawings.—However carefully and accurately an architectural drawing may be executed as regards the draughtsmanship, the appearance will be spoilt unless the colouring is carefully and neatly done. Architectural drawings are, of course, intended for use rather than for appearance, and the colouring is used chiefly to denote the different kinds of material, but this is no valid reason why a drawing should not be neatly finished as well as accurate in draughtsmanship and colouring. There is a wide difference between the various pigments used in water-colour drawing. Some flow much more easily from the brush than others; some are more transparent when laid on; whilst others may be more permanent, and so on. The best colourist is most likely to be the one who knows something of the materials he uses. The colours used for architectural drawings are, of course, water-colours, either in china pans or in the form of cake colours. If the selection be limited to ten colours, the following would probably be found as useful as any for the purpose required. (1) Ultramarine, a brilliant toned blue useful for representing glass, or in the case of perspective drawings it can be used for skies; rather a difficult pigment to mix with others. (2) Prussian blue is of rather greenish shade, but is useful for architectural drawings. Ironwork (more particularly wrought-iron), flint, and leadwork are suitably represented by it, although indigo is often substituted. (3) Crimson lake is a rich crimson; carmine is a similar colour which flows very easily. Both are suitable for brickwork in plan and section. Crimson lake mixed with blue answers for steel, although violet carmine could be used for it if preferred. (4) Venetian red does not possess a very bright tint, but is very useful for red facings in elevations. If Venetian red cannot be obtained, light red may be used instead. (5) Yellow ochre gives a warm permanent tint, is easily laid on, and is suitable to show stock brickwork in elevation. Roman ochre is similar, and could be substituted for yellow ochre. Gamboge might answer, but is hardly suitable, especially as it is sometimes used for indicating woodwork. (6) Burnt sienna is of a rich brown tint, and works easily. A pale wash of it answers for fir timber. Sometimes raw sienna or Indian yellow is used instead. (7) Burnt umber is of a subdued brown, useful for representing earth, also for oak timber. This pigment flows easily from the brush. Burnt sienna is sometimes used for oak, in which case it would be best to use Indian yellow or some similar tint for the fir. (8) Sepia is a pale brown useful for concrete or stonework. (9) Payne's grey is a kind of neutral shade, useful for cast-iron and slating; but a purple tint for slating on elevation can be obtained from crimson lake and blue. (10) Vandyke brown, violet carmine, or French blue would be found useful. If Prussian blue was used for lead, French blue would form a distinction for zinc. Violet carmine might answer for granite, otherwise a blue would have to be used. Indian ink has not been included in the above list as a pigment, although it is useful in colouring for showing old portions to be removed, etc. Chinese white, although very useful in general water-colour painting, is not a colour required for architectural work unless for very elaborately coloured perspective drawings. Clean water for mixing the colours is absolutely necessary. Work from left to right, working downwards, and never applying a second shade of colour until the previous wash is quite dry. Avoid washing over the inking in, or the ink may run. As regards brushes, brown sable are very suitable. They are sold in various sizes, such as crow, duck, small goose, goose, and so on up to large swan, or larger; that is, when they are in quills. When they are in square to round ferrules, they are usually denoted by numbers, commencing at nought. With working drawings as little shading as possible should be put in. In certain cases, ox-gall (in pots or in liquid form in bottles) is useful for making the colours flow evenly, but it should be used with great moderation and caution. It is not advisable to buy very cheap colours, as paints of excellent manufacture are to be had at very reasonable prices. The ten colours mentioned could be purchased in half pans or half cakes of good manufacture at a probable cost of five or six shillings, exclusive of the box. The dearest colours amongst them are French ultramarine, violet carmine, crimson lake, and sepia. The prices of japanned boxes of moist water-colours in pans are given in some price lists either (1) filled with colours of the makers' selection, or (2) for the empty box alone. This is very useful, as allowing persons to have the box filled with colours of their own selection. Bread crumbs applied lightly are very useful in removing any finger marks or pencil marks from drawings previous to commencing to colour them.

Removing Tablets from Window.—A good way of removing tablets from windows is to heat an ordinary flat iron (as used in the laundry) until a person can just *not* bear to touch it; then hold the iron on the tablet a few minutes, and, if fish glue was not used, the heat will loosen the tablets. Clean the window with paraffin.

Casting Brass Bushes on Iron Rods.—In casting brass bushes on iron or steel rods every care must be taken to prevent blowholes, which generally are caused by the molten metal becoming overheated in casting; there being no way for the combined gases to escape, they are held in the setting metal. The iron bars, if used in connection with the bush, should be heated in an oven till the hand can barely hold them, and must be placed in position in the frame just before pouring. The two sides should be made quite hot, and closed with a hot bar when the metal is just ready. Well stir the metal, and if too hot, cool it down. If hardness is immaterial to the bush, a small quantity of amorphous phosphorus, about a teaspoonful to 100 lb. of metal, may be added. This will cause the metal to run more easily, and ensure better results.

Converting Sea-chest to Settle.—In converting a sailor's sea chest 3 ft. 3 in. long and 1 ft. 3 in. wide, having an overlapping lid, to a settle having removable arms and back, the projections of the lid may be made the chief means of fixing the arms and back. In the design here shown the elbow-pieces are of 1-in. board, and, as will be seen by Fig. 1, two strips of ¾-in. wood (A and B) are screwed along the bottom of each elbow-piece, thus forming grooves which will slide over the projections; two small gimlet holes bored through the strips B and the ends of the chest, and fitted with metal pins,

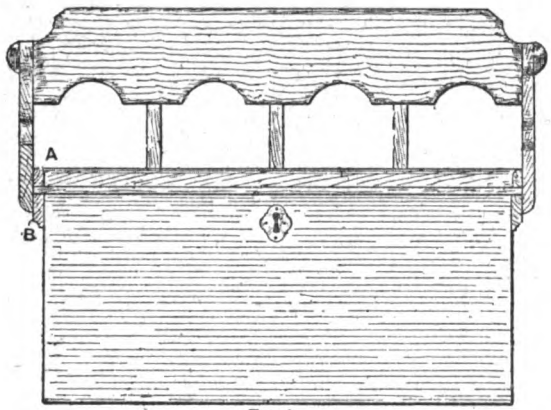


FIG. 1

FIG. 2.

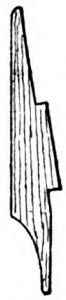


FIG. 3

Sea-chest Converted to Settle.

will hold all firm, or, when the pins are taken out, will allow of the ready removal of the whole superstructure by sliding it backwards. The back rises 15 in. above the chest, the elbows rise 9½ in. The shaping of the latter is shown in Fig. 2. The back (Fig. 1) has two rails of ¾-in. board. The lower rail, which rests on the top of the chest, is 2 in. wide, the upper rail is 8 in. wide; openings are cut for their ends in the backs of the elbow-pieces C and D (Fig. 2), in which they are strongly screwed. Fig. 3 shows one of the upright supports of the back. These supports are of 1-in. board 18 in. long. They are screwed to the two rails, and when strain is thrown on the upper rail, the lower ends of the uprights, pressing against the chest, will support it as by leverage. Screws through these pieces into the back of the chest would give still greater strength, but this would render the removal of back and arms less easy, and would scarcely be needed.

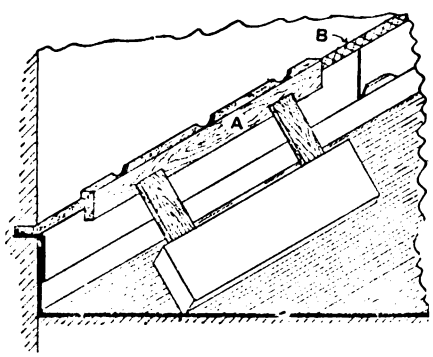
Backs for Account Books.—Before making the back for an account book, the book itself must be lined on the back, this being done after the book has been cut, rounded, and the edges marbled. It is usual to line the back of a good book with waste pieces of strong leather. The linings are cut to fit between the bands upon which the book has been sewn, and about 6 in. longer than the thickness of the back, so that they overlap about 3 in. on either side, if the book is a large one. These linings must be drawn on tightly and rubbed down well so as to ensure that they stick perfectly on both the back and the sides. Now, with a strip of paper, measure for the back. Lay the paper on the side of the book about ⅜ in. from the back, bring it over the back, carry it to ⅜ in. on the other side, and cut off. With this strip of paper for a guide, cut three strips of good hard millboard, a special thin but hard board for this purpose being known as "black board." The first strip must be cut exactly to the size of the paper, the second one a trifle wider than the first, and the third one wider still. These strips will of course be about 2 in. longer than the book. Then with strong glue fasten the strips of board together. Glue the smallest first and each larger piece in succession so that the exposed edges of each larger piece are kept clean and free from glue; place under firm pressure and then leave till dry. The back must now be rolled, a wooden roller covered with stout brown paper being necessary. The paper is glued at one end and fastened to the roller. Heat the back thoroughly over a gas flame or a bundle of lighted shavings and allow the heat to penetrate the boards, taking care to prevent burning. When the back is hot and pliable, place it in the roller and give one sharp turn; then reverse quickly and give another turn. It may require to be reversed several times to keep all the parts in place during rolling. Now roll up tightly, and with a flat board, such as a backing board, roll the back over the bench several times, pressing heavily all the time; then set it aside to dry. The diameter of the roller should be about half the width of the back itself. When the back is thoroughly dry it should be well rubbed down on the edges and forced on the back of the book. The waste sheet of the end-paper of one side of the book is now glued and folded back up to the linings and brought over the back. The other side is also glued and brought over the back in the same manner and all are well rubbed down, a board being placed on each side of the book close to the back and the whole put into a press and given a good nip to make all flat and draw the back tight. The linings and end-papers will have formed a kind of a hinge on each side, and with these the side boards are fastened. Make a cut in this hinge on both sides at the top and bottom (that is four cuts), about 2 in. in from the outside. This is to allow for turning in the cover. The boards for this class of work are made of several thicknesses, and the inside board of the series is generally a thin one; in making, this is only glued halfway. Now, after squaring up the boards, they are added to the book by gluing this part on both sides and inserting the hinge in the split, allowing the two small pieces to remain outside. When both boards are put on, the book is again pressed: when dry it is taken out and is then ready for covering in the usual manner.

Repolishing a Malacca Cane.—Malacca canes and walking sticks that are very much scratched may be repolished. Wipe the cane over with raw linseed oil, smooth down all roughness and scratches with fine grade glasspaper or emery cloth, then wipe quite free from oil. If the cane is of a reddish tinge, apply with a camel-hair brush one or more coats of mahogany furniture varnish; if desired clear, use brown hard spirit varnish. If the varnish is too bright, again wipe over with linseed oil when it is quite hard, and rub well with putty powder or jewellers' rouge, using a piece of woollen cloth for applying the oil. Finish off with dry powder and washleather without oil. This should have the effect of reducing the thickness of varnish laid on and bringing up a gloss instead of a shine as left by varnish.

Hardening Brass.—Brass can be hardened only by subjecting it to heavy pressure, by hammering, rolling, or wire-drawing. In the form of sheet, hammering or rolling will harden it. Brass, and alloys containing copper, cannot be hardened and tempered by heat.

Gum Lac.—All lacs resembling gum lac are popularly but wrongly called shellac, hence when application is made at the stores for gum lac, in the majority of cases shellac is tendered. The crude material, gathered from the twigs of trees, where it is left after the puncture of the bark by the insects known as *Coccus lacca*, is generally accepted by the commercial world as gum lac or stick lac, the products after various stages of manufacture being known as seed lac, shellac, lump lac, and cake lac, further classes or grades being lemon, orange, garnet, or button lac. When the gum is separated from the twigs, the first object is to free the resinous product from the colouring matter; this is done by frequent washings, the residue being afterwards evaporated to form cakes of dye known as lac dye.

Burning Lead Flashings to Terra-cotta Walls.—Burning lead flashings to stone or terra-cotta walls may be done in the usual way by filling the grooves with molten lead. The best way of running the lead is shown in the accompanying illustration, in which A represents a strip of dry deal, about 2ft. long by 2½ in. or 3 in. wide and 1½ in. thick, placed over the joint and held in position by struts against an opposite wall, or by a weight, as shown in the illustration. The groove at the ends of the running stick is plugged with clay or common putty to prevent the lead escaping. The lead is poured through the two outer holes, shown on the top edge of the stick, the centre hole being left open for air to escape. The lead should not be poured too hot. When the pouring is finished and the lead has set, the stick is removed, and

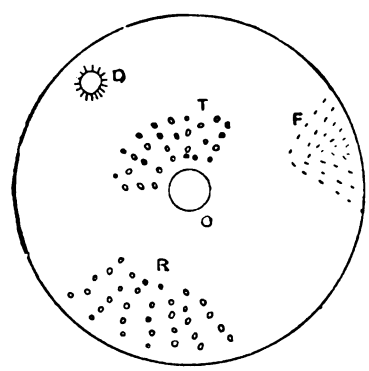


Burning Lead Flashings to Terra-cotta Walls.

the face of the run lead is cross-hatched, about 1 in. apart, with a blunt hand chisel, as shown at B. The lead should not be stayed or caulked in, as the edges of the groove would be chipped or stunned and eventually crumble or flake away.

Tin.—Tin (symbol Sn., atomic weight 118) has a specific gravity of about 7·3 and a melting point of 442° F. (227·7° C.). Whilst being more tenacious and ductile than lead, it is less so than zinc, as regards both of these qualities; and though more malleable than aluminium, it is less so than copper. A cubic foot of tin weighs nearly 456 lb. Tin has nearly the lustrous whiteness of silver, and oxidises only on being heated, when it forms stannic oxide. Tin can be dissolved by many acids, and easily alloys with most metals. The tin known to the metal-plate worker is not solid tin, but steel plate thinly coated with tin. Many of the more important alloys have tin as their principal constituent; some of these alloys are solders. Tin occurs in the form of sulphuret and oxide, but more generally in the form of ore, known as tin-stone. This is smelted either in blast or reverberatory furnaces. In the latter case the treatment is in two stages, one being the actual extraction of the metal and the other the refining. The roasted ore is washed to remove the sulphates, and is then placed in a furnace having an inclined bed and lined with about 8 in. of fireclay. Previous to placing in the furnace, the ore is mixed with anthracite and a small quantity of lime and fluorspar. At the end of five hours more anthracite is thrown into the furnace, and in about an hour's time the molten metal can be run off. The remaining slag is an iron silicate which contains some oxides. To refine the pig-tin, it is placed in a reverberatory furnace and gradually heated to the fusing point of tin; at this temperature the tin melts, and is drawn off into iron pots. The mass left in the furnace is "hard head," and contains for the most part iron. On again melting the tin and stirring it with a pole of green wood, it is caused to boil by the escape of gases, and by this means the impurities, such as iron and arsenic, are brought to the surface, from which they are skimmed. Grain tin is made by allowing the molten metal to fall from a height on to a hard, cold surface. To produce what is known as "common" tin, the metal passes at once to the moulds. "Refined" tin is the result of using better ores and lengthening the poling process. The purest metal in the mould is the upper portion; the middle portion is the "common," and the bottom portion is too impure for use at all, and requires another fusing and poling. The ingots are known as "block" tin.

Straightening Circular Saws.—The tools used for straightening circular saws include a cross-face and a dog-head hammer, a steel straightedge, and an anvil with a slightly convex face; a piece of chalk will be required for marking loose and tight places which occur in the saw-plate. The accompanying sketch represents a circular-saw plate. When being hammered, the part of the plate to receive the blows should lie dead on the anvil. The dog-head hammer is used for equalising the tension in the plate. The effects resulting from a blow with the dog-head hammer are shown by the marks D. The marks at T and R also denote blows from the dog-head hammer. A saw that is tight at the centre should be hammered as at T all round the centre hole until the required tension is obtained, the hammering being done on both sides of the plate. Should the saw be too tight near the rim, hammer as at R. As a rule, circular saws do not require stretching with the hammer at the rim, as the greater friction acts at that part when it



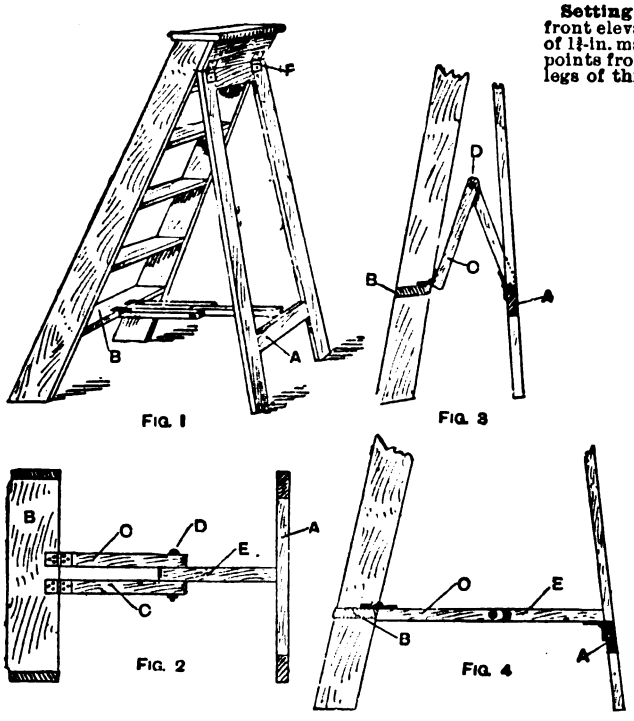
Straightening Circular Saws.

passes between the packing and through the timber. The taking out of a twist or bend is rather a difficult job for a novice. The hammering is done with the cross-face hammer as at F. After such hammering it is sometimes necessary to give a few blows with the dog-head hammer just outside the cross-face hammering, so as to equalise the tension. When truing a saw by hammering, the straightedge should be frequently applied to the saw-plate. A thick plate, of course, will require a more forcible blow than a thin plate.

Mastic Cement for Roofs.—A cement made as follows has been found to be very effectual for pointing ridge tiles and for roof work. Mix fine sand 56 lb., powdered litharge 6 lb., and quicklime 3 lb., with boiled linseed oil. Care should be taken to have the litharge ground fine. The mastic should be used immediately after mixing; it dries in about six hours. Some manufacturers use white-lead, lampblack, ochres, umbers, and Venetian reds for colouring purposes.

Fire Gilding.—Fire gilding proper is a process by which gold leaf or a thin plate of gold is made to adhere to the surface of copper, brass, or silver by means of heat and pressure. But there also is a process for gilding these metals by means of an amalgam of mercury and gold, in which heat is employed to drive off the excess mercury. The amalgam is prepared by soaking pure gold leaf in hot mercury until this will not absorb more gold; it should then be poured into cold water and well washed, when it will assume the consistence of soft butter. This must then be kneaded in salt water until the water is not fouled, when the amalgam is fit for use. The paste thus prepared is smeared over the cleaned surface of the metal to be gilded, then placed in a muffle of a gas furnace heated to 670° F. until the mercury is volatilised. The mercury vapour which fills the air around the furnace is highly injurious to health. The pure gold coating does not require colouring.

Safety Stretcher for a Stepladder.—Usually the back and front legs of a stepladder are connected by a cord or rope. In this there is an element of danger, for sometimes when the back legs are not fully extended a kick or a push to the ladder will make it collapse and fall, with, perhaps, awkward results to the user. The hinged stretcher here shown prevents the legs from closing while the ladder is in use, and the back legs cannot approach the step portion till the stretcher is raised by hand. In making the stepladder, the top edge of rail A (Fig. 1) must be level with the upper surface of step B. The wood strips of stretcher C (Fig. 2) should be made of the same width as the hinges—say 1-in. table or flap hinges; and the thickness of strips C should be about 1 in. The strips are connected at D (Figs. 2 and 3) by a thin bolt or screw; strip E (Fig. 2) working loosely on the bolt. When the back legs of the ladder are hinged at F (Fig. 1), the necessary distance of the back legs from the steps can be decided upon. Supposing this were 2 ft. 6 in., the length of strips C, to bolt at D, would be half, or 1 ft. 3 in. Care must be taken to allow

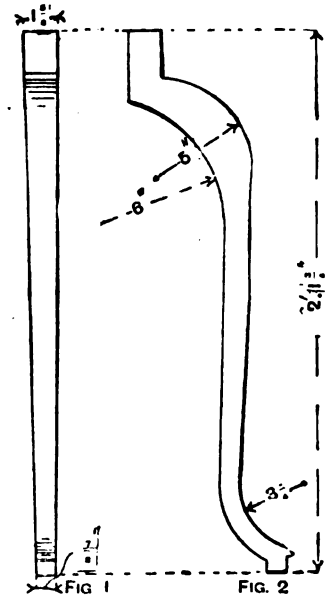


Safety Stretcher for a Stepladder.

the ends of the strips to fit against the edge of step B, as the butting against the step keeps the hinged stretcher from dropping beyond a straight line. The hinges must be fixed as shown in Figs. 2 and 4—that is, on the top surfaces of strip C and step B, and underneath strip, and on inside face of rail A of back legs. It will be seen that when the stretcher is in position the back legs cannot move inward or outward. Of the accompanying illustrations, Fig. 1 shows a view of the stepladder and stretcher; Fig. 2, plan of step and hinged stretcher; Fig. 3, side view of steps and back legs nearly closed; and Fig. 4, side view of stretcher when open.

Spotting Lantern Slides.—For convenience in placing slides the right side up in the slide carrier of an optical lantern, they are "spotted," and there exist one or two systems of doing this, though it would be to the general advantage if one system alone were universal. White spots on the binding of a slide are seen fairly easily by the side of a lantern whilst an exhibition is in progress, and so this means is adopted of distinguishing the top of a slide from the bottom, thus enabling it to be inserted properly. A very general method is to place the slide on a sheet of white paper; it must be the right way up, and just as it would appear if projected properly upon a screen. The two top corners then are spotted; when reversed in the carrier, the spots will be at the bottom and next to the lantern condenser. Another plan is to spot the right-hand top corner, this becoming the left-hand bottom corner when in the lantern. There is not much to choose between this and spotting the left-hand top corner, though the necessity for each person always spotting his slides in the same manner must be insisted on; inconsistence in spotting will cause many mistakes. The spots can be white pigment dabbed on with a camel-hair pencil, or they may be small circles of white paper gummed on. The combination cover-glasses and binders as bought will be spotted already, as a rule, and care must be taken that the spots come on the correct edge when the cover-glass is attached to the slide. Of course, when the spot is on the left-hand top corner, this becomes the right-hand bottom corner when the slide is inserted in the carrier. Also, when using an opaque screen or a sheet, the view on which is seen from the same side as the lantern, the spots on the slide go next to the condenser; when using a transparent screen, the slide is, of course, inverted as usual, but the spots go away from the condenser and next to the objective lenses.

Setting Out Patterns for Table Legs.—Fig. 1 is a front elevation of a shaped leg for a fancy table cut out of 1¼-in. mahogany; Fig. 2 is a side elevation, showing the points from which to strike the circles. In cutting out legs of this description, the best plan is to set out the



Patterns for Table Leg.

design full size on paper, glue the paper on a piece of thin deal, then cut the deal to the shape of the leg. Now take the plank from which the legs are to be cut and mark round the pattern with a lead pencil. The legs can be cut one out of the other, or rather, the pattern will follow, so that there will be very little waste.

Violin Resin.—Resin is prepared specially for use on stringed instruments; for double-bass bows good quality amber-colour resin is melted and strained through muslin into suitably shaped brass moulds. For violin bows a small percentage of tallow will be a desirable addition. Care must be taken during the process of melting that the resin does not take fire. The exact proportion of tallow required must be determined by experiment; as a rule, a very small quantity is added, its chief object being to give cohesion and prevent crumbling. It does not pay to make resins except in large quantities.

Mastic Cement for Kitchen Ranges.—Mastic cement for kitchen ranges, stoves, etc., is superior to that used for pointing (see p. 130), as it has to withstand a great heat. The following has been found very useful. Fine sand 28 lb., powdered litharge 14 lb., and quicklime 4 lb., mixed with boiled linseed oil. This is a trifle more expensive than the recipe given on p. 130, owing to the increase of litharge. It should be used immediately after mixing, as it dries in a very short time.

Preventing Wooden Posts Rotting.—The bottom of a wooden gate post should be treated with hot tar to prevent rotting before putting it into the ground. In some parts of the country a few cobble stones are placed at the bottom of the hole for the post to act as a drain. A circular slate or tile at the bottom is supposed also to be effective in "stopping the wet from rising in the post"; but their use is a doubtful advantage, as is also the practice of turning a post upside down to the way of its growth. The best method is to choose good heart-wood for the posts, dress it into its final shape, and let it get thoroughly dry before using. Before setting the posts, dip their lower ends, up to the ground line, into hot tar or into a mixture of tar and creosote.

Working up Scrap Guttapercha.—Guttapercha clippings are melted down in a steam-jacketed pan at a temperature of about 230° F., when they will form a plastic mass which may be rolled out into a cake on an iron slab, and then divided as may be required with a knife. Guttapercha could be made quite fluid by a greater heat, and it could then be moulded in tinplate moulds; but this method is hardly desirable, because it may render the material tender.

"At Home" Indicator.—Fig. 1 is the front view of an indicator for a house occupied by two parties, to enable one party to know whether the other is at home or not. It consists of a frame A, which is 10 in. long by 7 in. wide, and made out of ⅞-in. stuff 1 in. wide, mitred together and rebated on the top and bottom rails similar to a picture-frame as at B (Fig. 2), which is a section on line X X (Fig. 1). In the centre of the frame is a piece C, 10 in. long, ⅞ in. wide, and ¼ in. thick, grooved on both sides for the two boards D, which are 4 in. long, 2½ in. wide, and ⅛ in. thick, and fitted with knobs. A backboard E, ¼ in. thick, hollowed out slightly as shown in Fig. 2, is then fitted to the back. The whole should be black enamelled, and the words "In" and "Out" on both top and bottom painted white. In the illustration two words are covered up by the boards D, thus indicating that one party is "In" and the other party is "Out." If there are three families living in the house, three boards D, with three divisions in a frame 12 in. by 10½ in., will be required. An eye is fixed to the top for hanging the indicator to the wall of the house passage.

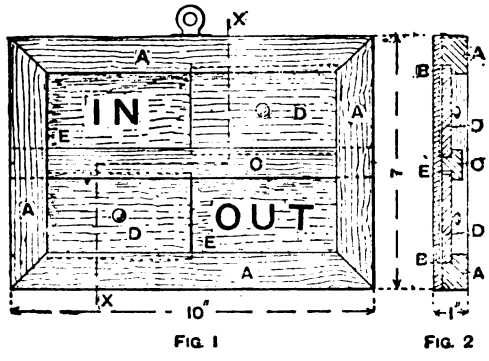
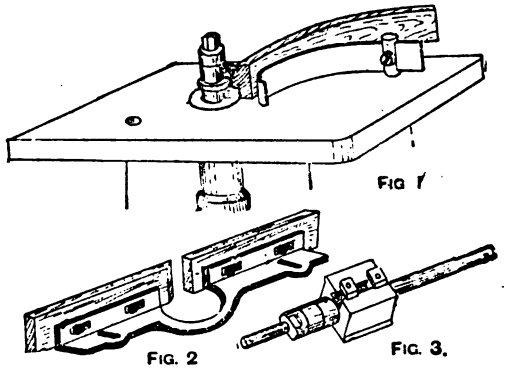


FIG. 1 FIG. 2

"At Home" Indicator.

Draughtsman's Set Squares.—Every draughtsman who has used set squares to any extent knows the difficulty experienced in obtaining a good square. Wooden ones are defective in several respects, being liable to warp, especially those made of pear wood; whilst framed set squares with a mahogany or pearwood frame and an ebony edging are expensive, and soon get out of order owing to the unequal expansion and contraction of the parts of the different woods. Satinwood, when not very well figured, is about the best wood for making squares, and if used with a bare ¼ in. thick for under 10-in. sizes, and a full ¼ in. for the larger ones, they will stand very well. Ebonite or vulcanite set squares are largely used; they do not warp or twist with changes of temperature, and the edges and angles will keep true for a number of years; but they are brittle, and if not used very carefully and wiped frequently make a black smear on the paper. These squares are generally made too thin, not possessing sufficient substance to press a piece of unmounted paper level, and in using them care has to be exercised to prevent the ink from running on to the edge from the pen and blotting the paper; they should be at least a full ⅛ in. in thickness. The best set squares are those made of transparent celluloid. This material has all the good qualities of vulcanite, and the further advantage of not smearing the paper; moreover, the lines underneath can be seen through them, which is a great help when working on some classes of drawing. Both vulcanite and celluloid squares are generally warped a little in the manufacture. This is rather an advantage with one having angles of 45°, as the hollow side can be kept on the paper, and when the hand is pressed on the centre in working, it will bed the corners and edges down firmly; but in choosing a square with angles of 60° or 75°, it is necessary to glance along the edge, so as to select an instrument that will have the hollow side on the paper when in the correct position for working on the tee-square.

Working Spindle Moulding Machine.—Fig. 1, which shows the table of a spindle machine fitted with cutters for working circular sash bars, illustrates the usual method of keeping similar circular work up to the cutter by means of a curved spring. This is adjusted by a set screw in the slotted spindle which carries the spring, and is itself locked in position by a nut under the table. The work is thus kept tightly up to a fence or collar fitting on the spindle, and fixed between the two cutters by means of the lock-nut shown on the end of the spindle. These circular fences may be placed either above or below the cutters as the section of the work may determine, and in the case of irregular mouldings a shaped wooden templet is usually fitted to them, and the work pressed up to the templet. The adjustment and attachment of these fences vary in different makes of machines, but the general principle is the same. An adjustable fence for sticking mouldings on the straight is shown by Fig. 2. Two holes are drilled in the table top and screw bolts are passed through these and the slots in the fence, locking it in the required position. In closet seats the work is usually fed up to the cutter without any further guide than the lines on the work. Small cutters for light work are usually fixed in slotted spindles, but heavier irons for wide mouldings and wide plane irons require square cutter blocks for fixing. Fig. 3 shows such a block attached to a loose spindle, which is fixed in a boring in the machine spindle.



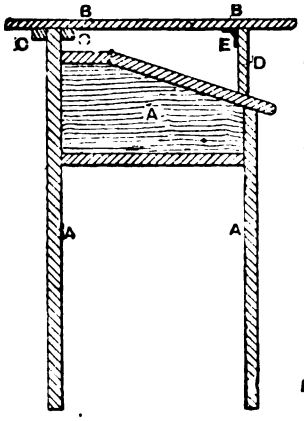
Spindle Moulding Machine.

Wood Naphtha.—Wood naphtha is prepared by the dry distillation of several species of wood. The wood is sawn into suitable pieces and placed in an iron still built into a furnace. Vapours then leave the wood and condense, the liquid being re-distilled several times and treated with sulphuric acid and lime, any residue remaining being acetate of lime. Commercial wood naphtha varies in composition; it is generally a mixture of methyl alcohol, allyl alcohol, and acetone in various proportions, the former being one of its chief constituents.

Old Furniture Stuffings.—It is certainly far better to use new furniture stuffing than to use moth-infested material. Pass any old stuffing once or twice through the willowing machine before using it again. If this does not suffice, the flocks will have to be washed, dried, and well teased; but it will not pay to treat cheap cotton flocks in this manner. Alva and cocoa-nut fibre are very seldom attacked by moths. If the stuff is used green or damp, it is subject to breeding small insects, and these are very difficult to destroy. Old flocks are used in weaving shoddy cloth and making heavy wrapping papers.

Powdering Herbs.—Herbs to be powdered should be dried thoroughly until they are quite crisp; they can then be powdered in a mortar or by shaking them in a sheet-iron box with a few large flint pebbles. If large quantities of herbs are to be treated, a ball mill would be most suitable. This consists of a cylindrical iron vessel revolving on a shaft; inside the vessel are arranged several sieves close to the external walls, and in it a number of steel balls are placed; baffle plates are arranged inside so that as the mill revolves the balls are carried to the top and then dropped into the material below; the powdered herb passes through the sieves down a hopper into a sack.

Converting Desk to Lantern Stand.—Perhaps the simplest way of converting a desk having a sloping top to a high table or stand for an optical lantern would be to make a board, about 2ft. 3in. long, 1 ft. 6 in. wide, and 1 in. thick. This would form the table, and would support the lantern, and at the same time provide plenty of space for slides, tinters, etc. At the end should be screwed a couple of pieces of wood, 1 ft. 4 in. long, 1½ in. wide, and 1 in. thick. These not only strengthen the table, but by fitting over the rail round the top of the desk prevent the table slipping should it be found necessary to tilt the lantern. At the other end of the table, a piece of wood, 1 ft. 4 in. long by 3 in. wide, should be hinged to fold inwards. This provides the back support and brings the table level. Should it be desired to tilt the table either way, place one or two wooden wedges under the back support. In the sketch, A is the desk, B the table, C the cross-pieces, D the back support, and E the hinge.



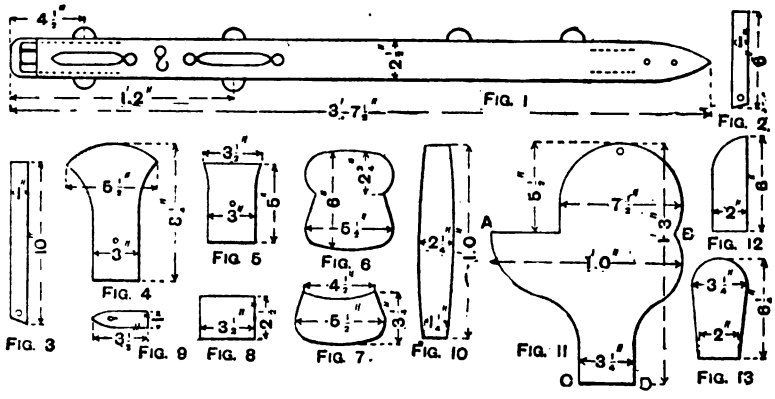
Desk Converted to Lantern Stand.

Tuning and Stringing Dulcimer.—Suppose that it is required to tune, so as to play in any key, a dulcimer 40 in. at the front, 15 in. at the back, 18 in. from front to back, and having thirty-three bridges. Without personal inspection it is difficult to give definite instructions, but probably the following chromatic scale will be suitable.

Treble bridges.	Bass bridges.
A♯ D♯	E
A D	D♯
G♯ C♯	D
G C	C♯
F♯ B	C
F A♯	B
E A	A♯
D♯ G♯	A
D G	G♯
C♯ F♯	G
C F	F♯
B E	F
A♯ D♯	E
A D	D♯
G♯ C♯	D
G C	C♯
Bottom.	C
	Bottom.

Some of the notes are duplicated; but, to get a full chromatic scale, this is unavoidable. The duplicated notes, however, will be found very useful in quick passages. The centres of the bass bridges should stand on a line drawn 2¾ in. from and parallel to the wrest-pin block. The treble bridges should be immediately over the inside bridge, the position of which will be seen on looking in the sound holes—presumably from 10 in. to 12 in. from the hitch-pin block at the bottom of the instrument. It is preferable to string the bass notes with brass wire, Nos. 10, 9, and 8 M.W. gauge, as it gives a fuller tone, but, if desired, all the wires used may be of steel. For the treble bridges, use Nos. 9, 8, and 7 steel wire. In both instances, string five notes each with larger sizes, and finishing with the finer. The quantity required will be about 2 oz. each of the larger and 1 oz. each of the finer sizes.

Sword and Pistol Belt.—Herewith are patterns for Sam Browne belt and fittings to hold a sword, pistol, etc. The belt (Fig. 1) has a two-pronged buckle, which is sewn in with fancy stitching, about ten or twelve stitches to the inch. The hook is for a ring which is at the back of the frog, and is used when the sword is not required to trail. Rings and dees are shown; the first two from the buckle are for the two straps on the frog when the sword is hanging loose, and those on the top of the belt are for the braces. The two holes at the bottom of the strap (Figs. 2 and 3) are fixed to the frog with a stud shown on its lower part; then the straps are carried to the rings on the belt. Fig. 4 shows the back of the frog, which has a ring at the back to hook on the belt when the sword is required to be carried in this position. The front of the frog (Fig. 5) has a stud for Figs. 2 and 3; it should be sewn on Fig. 4. Fig. 6 is the back of the pouch, and should have Fig. 8 sewn on to form a loop to slide on the right of Fig. 1. The front of the pouch (Fig. 7) should have a stud in the centre for Fig. 9 to button on, and should have the gusset (Fig. 10) sewn to it, this being then stitched on Fig. 6. Fig. 9 is the short strap to fix on the flap of Fig. 6. Fig. 10 is the gusset of the pouch to be fixed on Fig. 7. Fig. 11 is the holster; A should be brought to B and tacked, C being brought to D and tacked in the same way, and then closed together by stitching to the bottom. A piece of leather shaped like the barrel of a pistol at the point should be cut and closed in the bottom, the flap being brought over and secured with a stud. Fig. 12 is the loop to be sewn at the back of the holster, allowing it to slide freely on the belt with the pouch; this has two rows of stitching. Fig. 13 is the safe, which is sewn at the back of the buckle on Fig. 1. The braces, cut 1 in. wide, run through the rings on top of the belt (Fig. 1), crossing on the back. The length of braces and of the belt and straps greatly depends upon the size of the wearer, and should be made according. The holes shown on Fig. 1 are to be used as follows: The two single holes pass over a stud after the tongue is through the buckle and fastened. Dimensions are given for Fig. 4, and Fig. 5 must be of the same width. The same applies to Figs. 6 and 7, and the difference makes the flap. Fig. 13 is the back piece at the buckle, and is really a continuation of the belt; it is of the same width one end; the other end should be a little wider than the buckle. In Fig. 11, if A is brought to B, the upper part which forms the flap can be cut to lap over and fasten as stated. Finally, all parts should be made to fit the person and the weapons to be used.



Sword and Pistol Belt.

Polishing Stick and Umbrella Mounts.—A mixture of mutton fat and fine whiting can be used for polishing walking stick and umbrella mounts. The polishing can then be finished with a mixture of mutton fat and rouge, and finally on a dry buff. Equal results can be obtained with a jeweller's polishing brush and rouge.

Appliance for Cutting Strawboards.—One machine for cutting strawboards or cardboards consists of a wood or iron table A (see Fig. 1) resting on a framework and four legs. On the table are gauges, which can be so adjusted that the operator can cut the boards to any size required. Close to the edge of the table is a clamp to hold the boards in position while being cut. This clamp is worked by the foot, a treadle being provided at the bottom of the legs, near the floor. The boards are cut between two knives, one, B, being screwed flush to the edge of the table, and the other, C, being movable and screwed to the lever. The edges of the knives are bevelled like scissor blades; in fact, the machine is simply a large pair of scissors. A balance weight at the end of the movable arm carries the knife and keeps it in position. Both of the knives should be made of steel, and in tempering them avoid getting them too hard, or they will be liable to chip. Fig. 2 represents the gauge D on top of the table. This gauge is simply an L-shaped piece of metal; the shorter branch of the L is bent to lie close to the edge of the table. A slot almost the entire length of the gauge is cut in the latter. A thumbscrew screws into the edge of the table and fastens the gauge in position. The other portion of the gauge lies flat on the table. The clamp is a light casting shaped like Fig. 3. It is fitted to the table close up to the knife B, Fig. 1. A short rod is fixed at one end of the clamp and a longer rod at the other end, ending in a stirrup for the foot. These rods are fitted with springs which raise the clamp and hold it up until the foot is placed in the stirrup. A little pressure on the stirrup brings down the clamp and holds the board while it is being cut. The stirrup should reach almost to the floor for convenience of working. The side of the table and the front of the gauge must be a perfect right angle, otherwise difficulty will be experienced in cutting the boards straight. Strips of iron, not quite ¼ in. thick and perfectly straight on the inner edges, are screwed to the top of the table as shown. The strawboard is placed against these strips and the gauge when cutting, the clamp is applied, and the knife is brought down forcibly; this movement cuts the board. These machines are in general use amongst bookbinders, paper-box makers, etc.

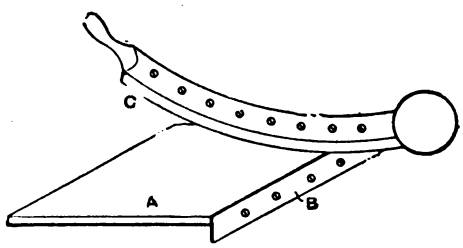


FIG. 1

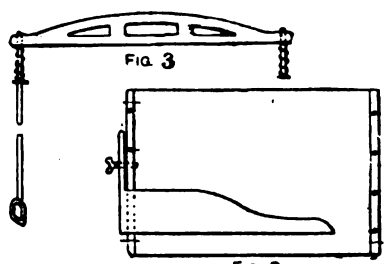


FIG. 2

Appliance for Cutting Strawboards.

Repairing Leaky Boats.—Leaky boats should be repaired in the winter and so by this means got ready for use in the summer months. There are three kinds of boats in use around the English coast, the first, and most common, the clincher-built boat, being called in some parts the lapstrake. Nearly all yachts' boats, skiffs, and ships' boats belong to this class. The boat is built so that each plank overlaps the preceding one, the planks being held together, and also to the ribs or timbers, by copper nails, riveted or "clinched" over a roove, or small copper ring, inside the boat, although in some of the cheaper boats the points of the nails are simply turned down inside the boat. This form of boat stands much knocking about, but generally starts leaking from two causes—first, from bumping on hard grounding; secondly, from being left out of the water too long in a hot sun, or cold dry winds. If the leak cannot be found, take all the boat's fittings and bottom boards out, and go afloat in her with a full crew aboard; the water will be seen coming in between the laps of the planks. Mark all places with chalk or pencil, and, putting the boat ashore, first tighten up the nails at each side of the leak by giving the rivets or clinches a few sharp blows with a light hammer, someone else holding on outside to the head of the nail with a heavy hammer. If this does not stop the leaking, put in a few more copper nails and clinch them up, taking care that the holes are bored with a bit or bradawl smaller than the nails. In a few cases of large clincher-built boats, say those over 20 ft. in length and heavily built, or those built of English elm, which shrinks very much in the sun, it will be necessary to drive up three or four threads of caulking cotton with a fine caulking iron between the laps or planks of the boat, and then to putty any remaining opening. The smaller clincher-built boats are also apt to have the planking split by running into a stake or anchor. If the split or "shake" is only a small one, the best way to repair it is to insert inside the boat a piece of wood (called by the trade a "tingle") wide enough to extend about 1 in. or more on each side of the split. This tingle will extend from timber to timber, and very often four or more will be required according to the length of the split. Between the tingle and plank put a coat of thick paint or varnish, and fasten the tingle in place with copper nails on each side of the split, turning or clinching them on the inside. The split is also puttied up on the outside with white lead putty coloured to suit the boat. If the plank is too far gone to be repaired, put in a new one moulded from the old piece, which can be taken out by cutting all the clinches with a very small cold chisel. If only a short piece of plank is put in, the scarfs may be 3in. or 4 in. long, and be well filled with white lead and fastened with small copper tacks turned into the wood. If the boat is found to leak along the keel, with a small hook (a small file shank turned over will do) rake out all the old putty, cotton, or oakum, and draw the plank into the rebate on the keel with some more copper or galvanised nails, and caulk and putty up. In cases of very old boats where the leak cannot be stopped, pitch or marine glue can be run with a ladle along the keel and laps inside when the boat is quite dry. But this greatly depreciates the value of the boat, and cement nearly always causes dry rot. In the second kind, carvel-built boats, the planks butt against each other, so that the surface is quite smooth; nearly all racing craft, both large and small, and also launches are carvel built. To discover a leak, put the boat ashore half full of water, and mark outside where the water oozes out: this will nearly always be between the planks. Rake out the old putty, and harden down the cotton or oakum with a fine caulking iron and re-putty. If the old cotton appears to be scanty or rotten, rake it out, and re-caulk and putty up. If the plank is very much injured, put in a new one, cutting out the old one and drawing the old nails. Mould the new plank from the old one; re-caulk and putty again. In some old boats, both clincher and carvel built, where it is hardly worth doing expensive or extensive repairs, a strong and satisfactory way is to tack a piece of lead sheet or thin copper sheet over a defective place on the outside, putting plenty of thick paint or, better still, Stockholm tar under it, and if any points come through the planking, turn them over with a light hammer. The third kind is the diagonal boats, which now are seldom to be found, except in Government boats and a few old P. & O. lifeboats. These boats are double skinned with tarred varnish canvas between the skins: they are very strong and very unlikely to leak, but when they do the leak is most difficult to find or stop, as the water gets between the two skins. The only way is to put them ashore and caulk and putty all the seams around the suspected place.

Lengths and Weights of Clock Pendulums.—Grandfather clocks and clocks which beat true seconds have pendulums 39¼ in. long. Vienna regulator clocks, which generally beat three times in two seconds, have pendulums 18 in. long. Half-second pendulums, as in some English dials and some American clocks, measure 10 in.; quarter-second pendulums, as in "tic-tacs," 2¼ in. But pendulums of all conceivable lengths between these are frequently used. The weights of pendulum bobs vary from 2 lb. to 5 lb. in grandfather clocks, and about 2 lb. in English dials to 1 oz. in little American and German clocks. As a rule, the better the clock the heavier the pendulum.

Forest of Dean Stone.—Forest of Dean Stone is a sandstone, and, according to Rivington's "Notes in Building Construction," this stone "is found in the Coal Measures near Lydney and Coleford in Gloucestershire. There are three distinct series or beds of considerable thickness. Of these the upper series consist of a soft, easily worked stone of various degrees of hardness. The second is harder than the first, and the third harder than the second, and of a finer grit. Both the second and third series can be quarried in blocks of any size. The first and second series are of a grey colour, the third is bluer. Some of the stone has a brownish tint. The stone weathers well if placed on its natural bed. Some used in the churches of Newland, Staunton, and Mitcheldean, that has been exposed for four hundred years, still retains the tool marks as sharp as ever, but this stone was, of course, carefully selected and obtained from the best quarries. The stone is admirably adapted for building or for heavy engineering work such as bridges and docks."

Cider Press.—Figs. 1 and 2 show elevations of an easily constructed cider press or mill for working by hand when used on a small scale; being fully dimensioned, the drawings are almost self-explanatory. The

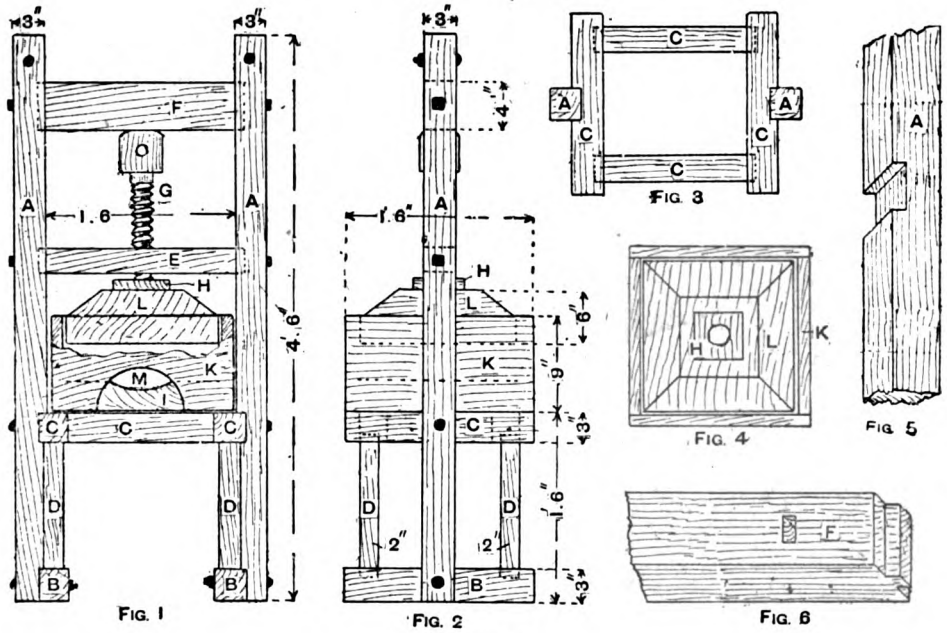


FIG. 1 FIG. 2 FIG. 3 FIG. 4 FIG. 5 FIG. 6

Cider Press.

plan of the bed I (Fig. 1) is given by Fig. 3, and of the platen L (Figs. 1 and 2) and pan K by Fig. 4. The standards A (Figs. 1, 2, and 3) are cut away as shown in Fig. 5, to receive the sills B (Figs. 1 and 2) and bearers C (Figs. 1, 2, and 3), to which they are fixed by bolts. The guide rail E (Fig. 1) and pressure rail F are connected to the standards by stub tenons and bolts with buried nuts, as shown in Fig. 6, the struts D (Figs. 1 and 2) being connected to the sills and bearers in the same way. The screw G (Fig. 1) is an ordinary wood bench screw, and, with the nut H (Figs. 1, 2, and 4), can be purchased at any ironmonger's. The bed is hollowed out at one side as at M (Fig. 1) to allow the juice to escape into a receptacle placed underneath, the side of the pan being cut away for the same purpose. The apples should be cut and placed in a bag of coarse canvas; this is then put into the pan and pressure is applied by means of the screw, when the juice will soon begin to run. The bag with the pulp will require turning a few times before all the juice is extracted, as it can escape at one side only of the pan. An easy way of cutting the apples into convenient pieces for crushing is to feed them through an ordinary turnip-cutter, but a mill for the purpose is described on p. 139.

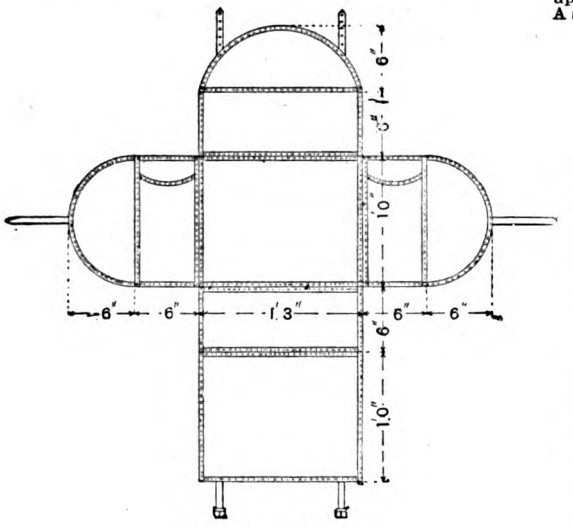
Clear Varnish for Fancy Wallpaper.—For a small quantity of clear varnish suitable for fancy wallpaper warm some Canada balsam until it is quite fluid and add an equal quantity of the best turpentine. Shake well till thoroughly incorporated, then set aside in a warm place till the next day, when the varnish will be fit for use. For larger quantities requiring a longer time to prepare, the following recipes may be used. (1) Mastic 2 lb., dammar 2 lb.; dissolve without heat in turpentine 1 gal. (2) Gum sandarach 1 lb., turpentine 6 oz.; frequently agitate for a couple of days, then add methylated spirit 3 pt. The varnish should be applied with a camel-hair brush in a warm room free from draught. Should the colours of the paper show a tendency to run together, dissolve one pennyworth of isinglass in ½ pt. of warm water; when cool, brush over the paper, working straight from end to end, and avoid going over any portion twice. When quite dry, give a second application, working in the opposite direction, thus ensuring that every portion of the paper is covered. When quite dry the varnish may be applied in the manner already described. The varnish will have a more solid appearance if the paper previously has been coated with isinglass.

Pebble Dashing.—Pebble dashing is best undertaken in damp weather; or, at all events, such work should not be done in very hot or dry weather, otherwise the brickwork of the walls will absorb the water from the cement and cause it to fall off. All joints in the brickwork should be raked out so as to give a key to the cement. Portland cement mixed with three times its bulk of clean washed sand is used and is laid in two coats. The first coat should be ½ in. thick and be roughed over with a birch broom or the ends of a bundle of laths so as to form a key for the second coat. The second coat, which should be ½ in. in thickness, is laid in small portions at a time. While each portion is quite soft the limestone chippings, gravel, spar, shells, or whatever is used for the ornamental covering, is splashed on to the cement with a flat wooden paddle, the chippings being contained in a bucket held close to the wall. The chippings need not be wet, but should be washed quite clean. An ordinary Portland cement will be found suitable, the time of setting only affecting the amount of space that can be laid at one operation before applying the chippings.

Making Chocolate.—In making chocolate paste the cocoa powder, sugar, starch, and other things are mixed together in the proper proportions, and then very gently heated in a steam-pan to melt the fat which the cocoa contains. The paste is then ground either in a small edge runner mill with granite rollers, or in the usual horizontal or sloping roll mills. The paste comes from these perfectly smooth, and is in perfect condition for moulding.

Copper-plating a Bicycle.—A bicycle to be copper-plated should be taken to pieces, and each part cleaned, scoured, and polished, as for nickel-plating. The parts must then be coated with copper in an alkaline coppering solution, connected with a dynamo or other suitable source of electric current. It is advisable to give the parts a light coat of copper at first, and then test this coat for adherence by a vigorous scratch-brushing. This will brush off any loose copper which may have gone on imperfectly cleaned spots. Then go over all again with a brush in the scouring bath, rinse, put in the coppering bath, and deposit a fairly thick coat of copper on each part. These must then be rinsed, scratch-brushed, and polished, after which they should be warmed and coated with zapon, or some other transparent lacquer, to preserve them. The alkaline coppering solution is prepared by adding ammonia to a copper sulphate solution until it becomes of a sky-blue colour; then add potassium cyanide until the blue tint changes to amber, resembling old ale.

Tourist's Waterproof Knapsack.—The accompanying sketch is given as a guide to the cutting out of a tourist's waterproof leather-lined knapsack. The outer material may be made either of waterproof brown canvas or rubber cloth, and may be cut out in one piece or



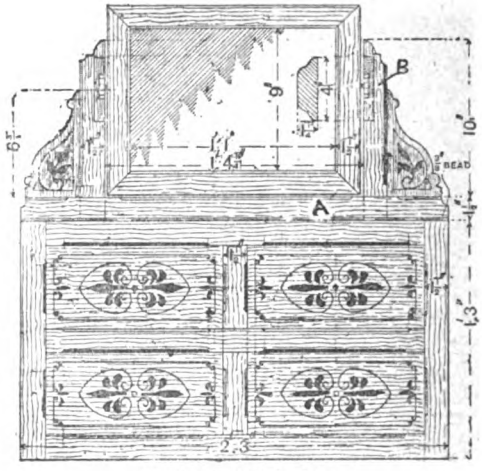
Tourist's Knapsack.

in separate pieces as desired, but in either case it should be bound along the seams and also on the edges, so that those portions may be doubly strengthened; if this be not done the material will crack at the folds and water will penetrate. Leather cloth would be very heavy as a lining. As a rule a board about ¼ in. thick, or a piece of wicker-work, is strapped to the back of the knapsack to keep it in shape. The pockets at the sides may be made in glazed calico as used for linings.

Half-tone Photographic Reproduction Process.—To describe fully what is called the half-tone process would occupy too much space, but briefly the process consists of making a negative through a screen (or network of fine lines) which splits the tones of the picture up into dots, which are smaller in the lights and larger and closer in the shadows. Behind this screen negative a sheet of zinc coated with bichromated gelatine is then exposed to the light. Those parts of the bichromate that have been acted on by the light become insoluble, and when the soluble portions of the bichromate have been dissolved away, leaving parts of the zinc bare, the picture is etched with acid. Considerable experience and proper training are necessary in order to produce the best results.

Lime Soap.—There are several lime soaps, and their properties vary. Lime soaps are combinations of lime with various fatty acids, known as calcium oleate, calcium palmitate, calcium stearate, etc. The first is a white, sticky, tenacious mass; the last a hard solid. All lime soaps, however, are insoluble in water, and therefore do not lather with water as do potash and soda soaps. Ordinary hard or soft soaps usually contain all three acids, oleic, palmitic, and stearic, in combination with potash or soda, and when these are used with hard water they produce a turbidity and a white scum owing to the lime in the water combining with the fatty acids in the soap to form an insoluble lime soap. A lime soap may be made by boiling ordinary hard or soft soap with water, and, after cooling, adding a solution of calcium chloride until the lather disappears. The sticky mass precipitated is the lime soap. The liquid may be run off, and the soap adhering to the pan may be washed several times with cold water. It should then be scraped on to a plate and allowed to dry. If a hard material is wanted, use white curd soap, but for soft stuff use soft soap.

Washstand Splasher.—The illustration shows a washstand splasher with glass. The wooden framework has four panels, the edges of the frame being stop-chamfered as shown. The panels can be ornamented with incised carving, then picked out in colour, painted, or stencilled. The original is enamelled, frame blue, panels white, and carving picked out in blue. If desired, the bar A may be omitted and the uprights carrying the glass tenoned into the top rail of the splasher. The frame for the glass is mitred and takes a piece of glass 1 ft. 1½ in. by 9½ in. A piece of wood B is screwed to the face of the uprights to carry the glass and allow of it being tilted. A side view of this piece is also given. If the arrangement of the wash basin permit, a wing similar to those of the glass may be fitted to each side of the splasher.



Washstand Splasher.

Removing Paint from Leather Bag.—To remove some black letters from a brown leather bag without injuring the leather, saturate the letters with turpentine applied with a piece of cloth; continue this till the paint is entirely removed, then cleanse the leather to remove the smell of turps. A new bag would be slightly discoloured by the turps mixing with the paint; in such cases it is usual to paint an oval or shield design over the initials, and, if required, paint fresh initials, say white on a black design.

Bell-metal Alloy. — Bell metal should be hard, compact, and of fine grain; it should be cast in a similar manner to bronze—that is, as the component parts of the metal have a tendency to separate out, it should, during the process of melting, be vigorously stirred, to ensure thorough mixing. If the bells to be made are small, a number might be cast at the same time, and the metal run in the moulds after it has begun to thicken in the ladle or casting-pot, as generally it is when the alloy is in the mould that the heavier metal tends to sink to the bottom. The quantities may vary according to the size of the bells, the variations of tone being gained both by grade of metal and thicknesses. The following may be accepted as a guide. For gongs, copper 82 parts, tin 18 parts; for house bells, copper 80 parts, tin 20 parts; for large bells, copper 76 parts, tin 24 parts. The copper must be melted first, then the tin is added, and, after vigorous stirring, the mixture is poured into the moulds.

Creasing and Tufting Upholstered Furniture.—In creasing and tufting upholstered furniture, such as chair-backs, much depends on the covering and stuffing material. With a light thin covering and long stapled horsehair any amount of set can be got by simply tying down; but with a heavy covering such as morocco or duck-backed American cloth leathers and a flock stuffing, the flocks are worked away from the buttons with the regulator; this has the effect of allowing the buttons to set deeper and sets up the tufts. For deep lap creases allow ½ in. in each tuft for laps when cutting off. Mark off the positions of diamonds or squares on the squab with a tape measure and chalk, then stitch down the tufts with twine, letting this take the form required for the tufts. Mark the same design on the face of the cover, fold down the lap pleats, and lightly hammer on a lap iron with a hide-faced hammer preferably; this will give the pleats a permanent set. The cover is laid on and the creases are worked in the sinkings made by the twine, and the buttons are set where the four stitches meet; all the tying off is done before the covers are tacked fast at the edges.

Fan Blower for Brazing Hearth.—The accompanying drawings, which are to a scale of 1 in. to the foot, show a small fan blower that will give a blast of 4 oz. pressure to the square inch, and will deliver about 60 cub. ft. at 2,200 revolutions per minute; such a blower is suitable for use with a brazing hearth. Fig. 1 illustrates the fan complete, Fig. 2 shows the fan with one half of the outer case removed, whilst Fig. 3 is a section.

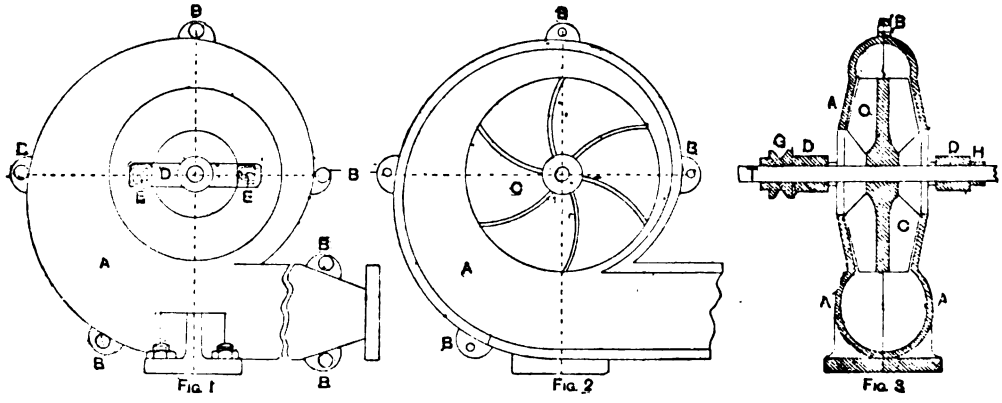


Fig. 1 Fig. 2 Fig. 3

Fan Blower for Brazing Hearth.

As the whole of the fan is of cast-iron, patterns will have to be made; but this is not very difficult as core boxes are not required, and any ironfounder will cast the parts. The case A is in two parts, fastened together with bolts at the lugs B. The joint must be well fitted and made airtight with thick oiled brown paper. The disc C and the vanes are cast in one piece, the vanes having a curve as shown in Fig. 2. At the air inlet the vanes must be cut away as in Fig. 3 to enable them to cut into the incoming air. The vanes must run as close to the casing as possible, only sufficient clearance being left to allow them to revolve without touching. The disc is secured to the shaft either with a key or a set-screw as preferred. The bearings D are secured to the outer casing by the studs E; the shaft T is of mild steel. G is the pulley for a round belt, and H is a collar. Both collar and pulley are fastened to the shaft by set-screws, and set so that the disc may revolve without touching the case. From 3,000 to 3,300 ft-lb. per minute, or $\frac{1}{10}$ horse-power, will be required to run the fan.

Transfer Decorations on Wood for French Polishing.—A satisfactory plan of transferring prints from paper to wood which is to be afterwards French-polished is to procure designs that have been printed on specially prepared paper. For furniture decoration designs can be obtained in perfect imitations of inlaid woods (commonly called marqueterie) in the form of centres, corners, end pieces, and bandings; designs can also be obtained in gold, pearl, and colours, and all can be readily applied to French-polish surfaces. Best results are obtained when the transfers are applied during the process of polishing; that is, the transfers should be fixed after the work is simply bodied up. The subsequent process of finishing with white (that is, transparent) polish will give the decorations such depth and solidity that the difference between this and real inlaid work will be hard to detect. The considerably lessened cost and the excellence of the imitation has led pianoforte and furniture manufacturers to use these transfer decorations extensively. The transfers can also be used by the house-decorator and the coach-painter, and are placed in position just before the application of the last or the last but one of the finishing coats of varnish. The transfer on to a French-polished surface of prints from books and illustrated papers is, when compared with transfers made on specially prepared paper, a tedious and sometimes vexatious process. In the case of special transfer paper, all that is necessary is to apply to the front or printed side of the transfer a fixative medium, such as oil varnish reduced with turps, gold-size reduced with turps, gelatine dissolved in hot water, brown hard or white hard spirit varnish. The medium is applied with a camel-hair brush, giving a thin and even coat. When the medium is tacky or sticky, place the picture face downwards on the article that is to be decorated; with a soft cloth rolled into a ball press the picture on the wood, starting from the centre towards the edges in order to drive out all air bubbles. For large pictures a rubber roller, as used by photographers, will be found useful; the secret of success is to bring the print into close contact with the wood at every point. Allow at least half an hour for the varnish medium to dry (if time permits, allow several hours), then with a soft sponge and lukewarm water damp the paper, pressing the sponge down on it; afterwards apply water more freely and lift or slide the paper off the wood. Remove all surplus moisture with a clean moist washleather, and set the work aside for at least half an hour; finish either by the application of varnish or by French polishing. In the case of coach-builders' and decorators' work, the transfer, which requires no fixative medium, is placed in position before the last coat of varnish is quite dry, pressed well into contact, and the paper afterwards removed as described above. If the varnish has been allowed to get a trifle too dry, damp the back of the paper with spirits, then press well into contact. Prints from books, etc., should be selected with care; the picture when transferred must not appear left-handed or grotesque. Coloured prints are rarely effective, owing to the arrangement of the colours; black prints are most effective on a light background. The surface that is to be decorated having been polished with transparent polish, the print should be soaked in a dish of methylated spirit for a few seconds, placed in position, pressed well into contact, and set aside for several hours. The paper (being frequently soaked with clean water) is then removed by gently rubbing with the finger tip.

Concentrating Sulphide of Lead.—Sulphide of lead, that is galena, the principal of the lead ores, is first ground under edge runners. It is then transferred to the first of a series of tanks laid in sloping ground so that the upper edge of one tank is a little higher than the preceding one. A slow stream of water is run through the first tank, and in this the powdered ore is thoroughly stirred. When the tank is full the water overflows through a spout to the next tank below, and so on through a series of four or five tanks. The lighter material, which is the impurity, is thus carried away; some is deposited in the other tanks, but the finer part runs away into the stream. Almost pure sulphide of lead is left in the first tank. From time to time the deposits in the lower tanks are transferred to the upper tank to recover any sulphide in them.

Caulking Ship's Deck.—Ships' decks are caulked by the aid of the following tools. Caulking mallet, reaming-iron, caulking-iron, fine and coarse set- or making-irons, spike-iron, bent-iron, and jerry-iron. The operator sits on a box or stool from 12 in. to 14 in. high, and works from left to right, and coils in the thread of oakum by the aid of the forefinger of the left hand. When deck planks are being prepared for any vessel, prior to seasoning, a shaving, varying in thickness from $\frac{1}{16}$ in. to $\frac{1}{32}$ in., is taken from the upper edge to nothing at a depth of from 1 in. to 2 in. or more down each side of the plank. When the planks are set tightly in position, the lower seams are closely in contact. The upper seams have a wedge-shaped mouth to admit of their being properly reamed, caulked, and payed. When a leak is discovered (a leak often is due to the rotting of the plank or inferior bolt fastening), the oakum as well as the old pitch should be jerried out, and care and caution must be exercised, for if the deck plank be thin, or not laid over the top of an iron deck, the oakum will be driven through and the seams of the planks spoilt below if heavy blows are given. The oakum is spun very loosely, the thickness of the thread depending much upon the thickness of the plank in new work, and often from four to six of these threads are driven in.

Bookshelf with Drawers.—Fig. 1 shows the front view and Fig. 2 the side elevation of a bookshelf intended to stand on a side table. Details of drawers are not given,

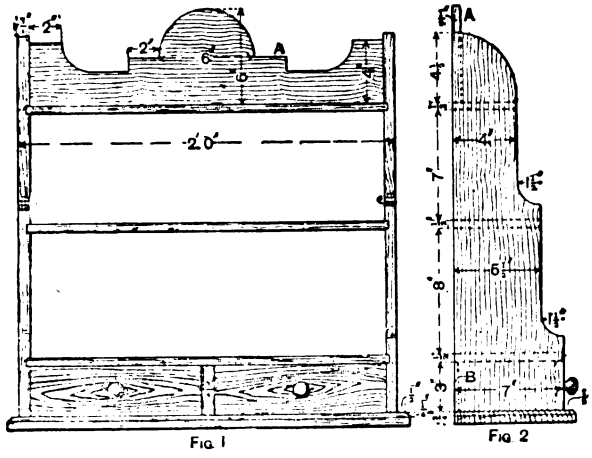


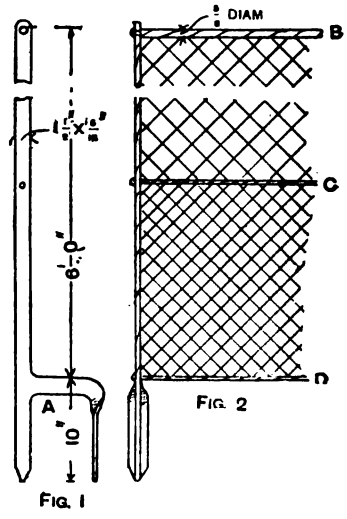
FIG. 1 FIG. 2

Bookshelf with Drawers.

as these are of the usual pattern and make. A wooden back would strengthen the bookshelf, but for ordinary use the ornamental top A (Figs. 1 and 2) and the piece of backing B (Fig. 2) behind the drawers will be sufficient.

Springs for Roller Blinds.—Springs used for the spring rollers of roller blinds are made of charcoal spring wire ranging in diameter from $\frac{1}{32}$ in. to $\frac{1}{4}$ in., according to the size of the barrel and strength required. For ordinary inside roller blinds the barrel is $1\frac{1}{2}$ in. or 2 in. in diameter, and the spring should be wound on a mandrel about half the diameter of the barrel. Springs for such rollers can be made on any lathe, which must rotate the reverse way to that required for turning, or else the worker must stand behind the lathe and the pedalling be done by an assistant. The coil of wire must be placed on a revolving frame and the right end of the coil (the end which unwinds freely) must be found by trial. Hold the wire with cloth or canvas, or wear stout gloves. The mandrel should have a hole across its axis near the end and the chuck should be prevented from unscrewing as the movement is reversed. Wind with slight tension on the wire and as regularly as possible; try not to cease until the spring is wound. When enough is made, let the lathe return until tension is released, then cut the wire. The spring will then be of larger diameter than the mandrel on which it has been wound. Note how many times the lathe turns to release the tension; this will be the limit to which the spring will bear turning afterwards. The finer the wire used on the same mandrel, the greater the quantity of wire is employed and a weaker spring is the result, but it is more suitable for a lighter cloth. If the roller is short and the spring is insufficient to draw a long cloth, two springs must be used, the inner one, of course, being wound on a smaller mandrel and begun at the reverse end to the outer one; one end of each must be whipped together with binding wire and the free end of the smaller spring made fast to the rod. The free end of the larger spring is secured to the block of the roller. To secure freedom of movement, all the centre rods of the rollers which are over 2 ft. long should be bent upwards as much as the diameter of the barrel will allow, but the ends of the rods which pass through the blocks must be in line. The spring must always be fixed so that it can extend in length freely, and the pulling down of the blind must tend to wind the spring more closely. The rod must be marked so that the curve shall be upwards when fixing and so be effective. Nothing is gained by too much or too thick wire, but attention to the behaviour of wire when wound, and to the various sizes, will show the suitable sizes of wire, barrel, and mandrel.

Movable Fowl-run.—For a movable fowl-run, iron hurdles may be used; these may be made about 6 ft. long and 6 ft. high, three standards being used for each hurdle. These consist of bars of $1\frac{1}{2}$-in by $\frac{1}{8}$-in. iron with a tee-piece A (Fig. 1) welded in 10 in. from the bottom, the end being bent at right angles and twisted to form a stay when the hurdle is fixed in the ground. A $\frac{1}{2}$-in. iron rod is used for the top rail B (Fig. 2), and three-ply wire at the bottom



Movable Fowl-run.

D; 2-in. mesh wire is stretched above C and 1-in. mesh on the lower portion of each hurdle. If the run is wired on the top the hurdles need be made only about 4 ft. high. The runs may be constructed from five or more of these hurdles.

Water for Photographic Purposes.—It is quite customary to employ ordinary tap water for some photographic purposes, but solutions of gold, silver, platinum, and oxalates should always be made with distilled water. Boiling ordinary water will drive off carbonic anhydride and remove carbonates of lime and magnesia, or lime may be added to water, and the precipitate allowed to settle. Adding to water a little of the silver or oxalate solution and allowing the precipitate to fall will render the water suitable for preparing solutions of these substances. Organic matter is removed by allowing the clearing action to take place in sunlight. Sulphates may be removed from water by the addition of barium nitrate.

Ridding House of Beetles.—It is a fact that phosphorus paste will certainly rid a house of beetles. The small penny bottles should be procured, and opened as required, as the paste deteriorates after long exposure to the air. Mix the paste with an equal quantity of ordinary moist sugar, divide into lumps about the size of filbert nuts, and place these lumps on pieces of paper put near where the beetles come. If this is done for two successive nights the beetles generally disappear for a month or two, according to the time of the year. When the beetles reappear phosphorus paste should be again spread in their haunts. It is doubtful whether any remedy is good for ever; but the phosphorus is good for a time and requires but a few minutes to spread.

Spinning Hollow Metal Balls.—Balls, such as bedstead balls, vases, etc., might be made by first spinning a cup and then fixing the head in a hollow chuck with the end of the poppet in the centre to hold it firm and then gently spinning the cut-off edge. But the balls are generally made in presses, the hollow cup being first of all drawn through in a machine, cut off to the required length, and the round end inserted in a die in a press, the head of the press being fitted with a cup-shaped die. This is brought down on the cut-off edge of the cup in the bottom die and squeezes it in. It is then softened, and a second pressure will make it almost a complete ball.

Flash Lamps for Photographic Purposes.—A photographer's flash lamp is an apparatus for blowing magnesium powder through a flame which ignites the powder, a dazzling actinic light being the result. An ordinary tobacco pipe, round the bowl of which is twisted some cotton-wool soaked in methylated spirit, may be used as a flash lamp. The powder is placed in the bowl of the pipe and blown through the flame by a tube attached to the stem of the pipe. The powder may be blown out by placing the end of the tube in the mouth, by means of a rubber bulb, or by a bicycle pump. An Argand gas burner with the centre fitted to contain the powder may also be used.

Cider Mill.—For a cider mill which is required to pulp apples, make a strong trestle of hard wood, using stuff about 3 in. square, as shown in Figs. 1 and 2, framing ½-in. square iron bars across the top frame as at A (Figs. 1 and 2), keeping the bars little more than their diagonal width apart and fixing them as shown by Fig. 3. Now

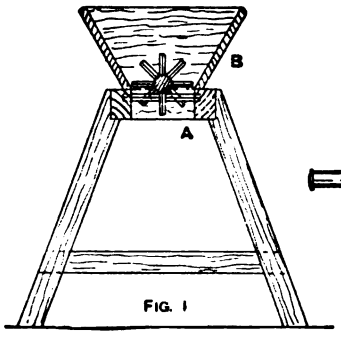


FIG. 1

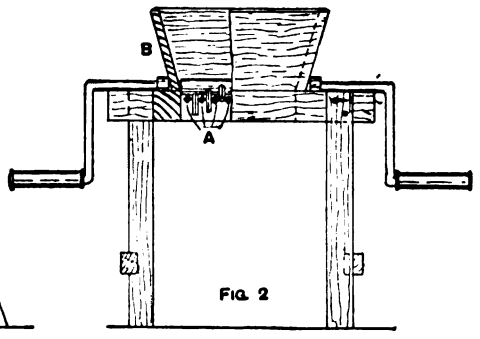


FIG. 2

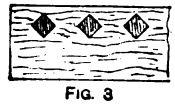


FIG. 3

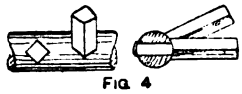


FIG. 4

Cider Mill.

make a hopper, as at B (Figs. 1 and 2), of 10-in. by 1-in. pine; this will be fixed in the position shown. Next make the spindle, in which short lengths of ½-in. square bar must be fixed at intervals to pass between the bars framed across the top of the trestle. Fig. 4 shows the method of fixing the ½-in. bars, which must not be placed in a line but spirally round the spindle (see Fig. 2). Crank the ends of the spindle to form handles, one end up, the other down. The barrel may be of 1¼-in. iron and the ends ¾ in. in diameter. The spindle may have a simple bearing. A cider press is illustrated on p. 135.

Gypsum.—Gypsum (known also as plaster-of Paris) is a sulphate of lime occurring in several geological formations, but especially in connection with deposits of common salt in the triassic system. Gypsum is sold either in its crude state—that is, after simple grinding under edge runners—or after treatment with acid to remove iron, etc., and thus render it white. Its chief use in these states is as a weighting or adulterating material in pigments and similar products. A form of gypsum is produced as a bye-product in chemical works, and is called pearl-hardening or satin white, owing to its crystalline or satiny appearance; this is used in facing paper and cards, also largely in paper staining as a base for colours. (See also Series I., p. 17.)

German Silver or Nickel Silver.—In making the alloy known variously as German silver, nickel silver, and Chinese silver, there is difficulty in combining definite proportions of the metals owing to volatilisation. Mix together grain copper and nickel in certain proportions and melt them in a crucible, then add zinc and a piece of borax the size of a walnut; the zinc dissolves slowly in the molten copper, and the heat is increased with the fluidity of the metals. It is desirable to employ oxides of all the metals except the copper, and to reduce them to the pure metals by the aid of a flux, this practice being good in forming nearly all alloys. The common commercial zinc is not pure enough for making German silver. The proportions of the metals constituting the alloy are given in the following table:—

	Copper.	*Iron.*	*Iron Cobalt.*	*Lead.*	*Nickel.*	*Silver.*	*Zinc.*
No. 1	50	—	—	—	25	—	25
No. 2	60	—	—	—	25	—	20
No. 3	62·5	—	—	—	12·5	—	25
No. 4	60	2	—	3	20	—	20
No. 5	60	—	—	—	22·2	—	17·8
No. 6	49·5	2·5	—	—	31·5	—	25·5
No. 7	65·2	—	12	—	13	2·5	19·5
No. 8	53·39	—	—	—	17·4	—	13
No. 9	50	—	—	—	19·3	—	13·6
No. 10	50	—	—	—	50	—	—
No. 11	66·6	—	—	—	33·4	—	—

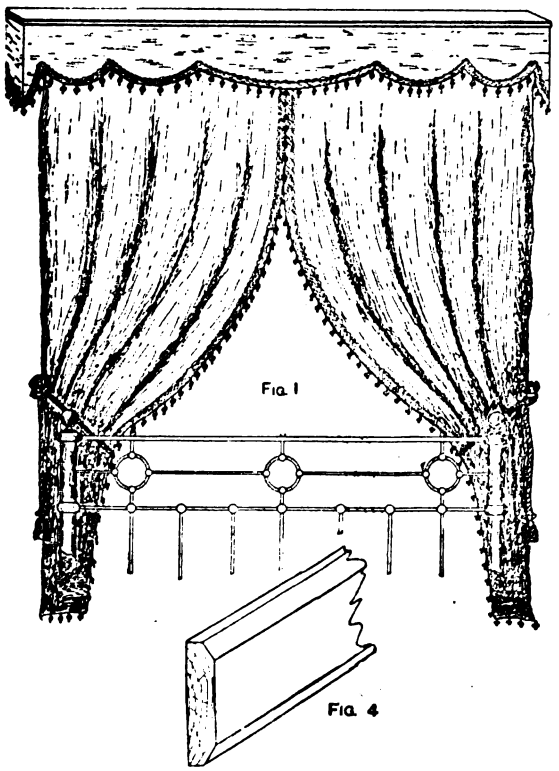
Nos. 1 to 5 in the above table are the proportions for the usual alloys; 6 and 7 are for the Chinese silver, known also as Pakfong silver and as Chinese white copper; 8 is for Frick's German silver; 9, for Parisian silver; whilst 10 and 11 are the proportions of German silver alloys guaranteed by Pelouze to be excellent.

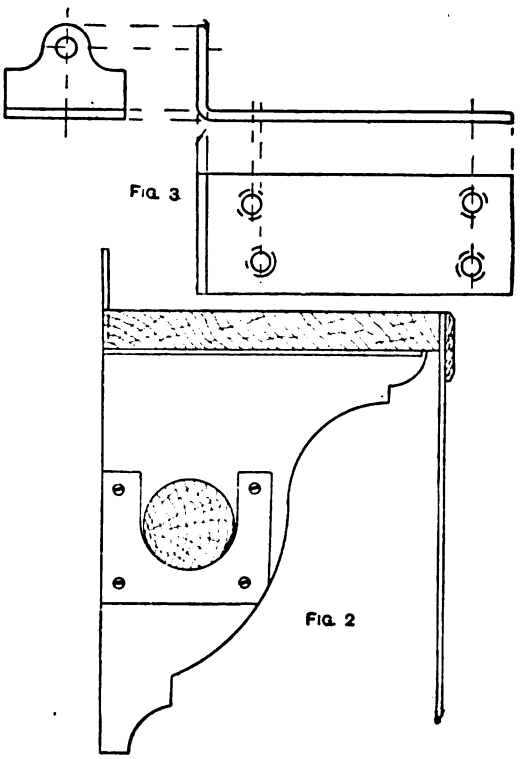
Cementing Glass to Brass.—One of the best cements for this purpose is Canada balsam, which may be bought in the form of a yellow honey-like substance. To prepare it for cement, place it in a small saucer, and heat in a moderately hot oven for several hours. When cold it should be quite hard. Now break it into small pieces, place them in a bottle, add a little benzene, and put the bottle carefully in warm water. When the balsam has all liquefied, allow it to cool. It should be nearly solid when cold. If this is so, again melt by warming, and apply it to the parts to be cemented; warm these carefully, both before and after applying the cement, and bring them together. In a few days the cement will be quite hard.

Acetylene Lamp.—To make an acetylene lamp, first construct a tin or brass outer case large enough to receive one of the charges of carbide sold ready made up in small tins for cycle lamps Around the tin charge there must be a space of about ½ in.; at the top of the outer case must be a gas-tight lid in which a safety valve is put. The tin containing the carbide is perforated at the bottom and has an open nozzle at the top To start the lamp, place the charge inside, pour water in to reach nearly to the top of the charge, and instantly secure the top. Water at once enters the perforation at the bottom of the tin and causes gas to be made until sufficient accumulates to prevent more water entering, but as the gas is used more water will enter and more gas be made. The burner could be attached to the top or side of the outer case (above the water line), and to get best results a piece of rubber tube should be made to connect the top of the charge and the burner orifice inside the tin. Perfection must not be expected from so simple a lamp.

Preservative for Stone.—A petrifying composition for arresting decay in stone may have the following ingredients. Resin 20 lb., litharge 10 lb., slaked lime ½ lb., milk of lime ½ lb., coal-tar naphtha 1½ gal., oak varnish 1 qt. Melt the resin and add the naphtha and finally stir in the other ingredients. The solution should be passed through a sieve before use.

Decoration for Head of Bedstead. — A pleasing decoration for the head of a French bedstead consists of a pair of curtains, which may be silk, tapestry, or cretonne (as shown by Fig. 1). The curtain hangs from a pole 1 in. in diameter, supported by two small brackets (see Fig. 2). The brackets are of ash or birch, or other hard wood, and on the inner side of each is screwed a small slot piece (see Fig. 2) into which the pole fits. The pole can be removed readily. The head board is 3½ in. wide and about 1 ft. longer than the width of the bedstead. The brackets are securely glued and nailed to this board, which is then fitted with three eye-plates (Fig. 3). These can be cut from sheet brass or drilled and bent from 1½-in. by ⅝-in. iron, and screwed to the wooden wall plugs. A valance about 9 in. deep cut from velvet to the design in Fig. 1 is hung from this board and fixed with small gimp pins. The valance is edged with ball fringe, which should be





Decoration for Head of Bedstead.

sewn after the valance is hung, so that the material is not pulled out of place. The fringe must be cut to length to fit the curves and neatly mitred at the intersection, the joint being then hidden by sewing on a ball cut from the fringe edge. Along the upper edge of the valance a flat gilt moulding (Fig. 4) is fixed with needle points. The curtains are edged with ball fringe and looped back with heavy cords and tassels fixed to the wall with rosettes. They should hang about 4 ft. 6 in. above the head of the bed and 3 ft. below the top rail. On the head board might be placed one or two ornaments, such as plaques or bronzes.

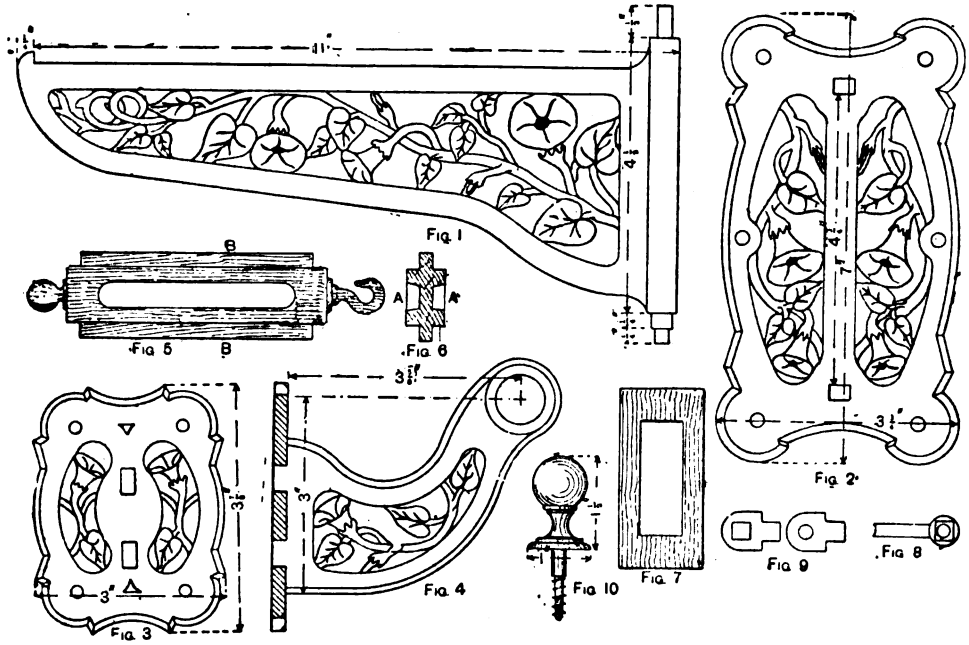
Porous Pots and Plates for Batteries.—Porous pots as used in battery cells are mere pots of unglazed earthenware, a material similar to that of which ordinary flower-pots are made. The clay must be first well washed, the milky fluid run off into tanks and allowed to settle, then the clear water drained off, and only the remaining mud used in making the pots. These are made in suitable moulds, then dried slowly, and finally baked in a potter's kiln. Porous plates are made in the same way.

Methylated Spirit.—Methylated spirit is usually prepared by mixing 10 parts of wood naphtha and 90 parts of commercial spirit of wine with 4 per cent. of refined petroleum oil; the latter is added owing to restrictions being placed upon the spirit by the Excise, so as to render it unfit to drink; it also contains very small quantities of acetic acid and resinous bodies. Commercial spirit of wine contains 86 per cent. of pure spirit or alcohol; it is very little used in preparing spirit varnishes on a large scale, owing to the Excise placing a high rate of duty on it. Methylated finish is much used by spirit varnish manufacturers; it is prepared by adding 1¼ lb. of resin to 1 cwt. of methylated spirit, this being an Excise regulation to make the spirit undrinkable. When mixed with water it resembles milk, and throws down a white precipitate; it is much used owing to its cheapness.

Emptying Cesspools.—The best method of emptying cesspools is practised in Paris. The apparatus consists of an iron air-tight cylinder or tank on wheels, a connecting pipe leading from the tank to a pneumatic pump, which is worked by a small portable engine, also on wheels. One end of a hose pipe is attached to a stop-cock at the end of the cylinder, the other end of the hose pipe being immersed in the sewage in the cesspool. The pneumatic pump, worked by the steam engine, exhausts the air from the cylinder, and the pressure of the atmosphere on the surface of the cesspool forces the sewage into the cylinder or tank on wheels. The ordinary method of emptying a cesspool is to use a chain pump to raise and discharge the sewage into a night-soil cart. A disinfectant such as chloride of zinc, carbolic acid, or dissolved permanganate of potash, can be used; it is, however, very difficult to avoid all nuisance.

Adjusting Pressure in Spinning Metal.—Since the general method of spinning metal in the lathe is by manual power, the only way to reduce the pressure is by not bearing so heavily on the tools. The metal must be annealed oftener. In cases where machine pressure may be utilised, it would be necessary to exercise care, since if the metal were too thick, holes might result; while if thinner, the metal might pucker. With machine work, according to the thickness of the metal, so the tension would need adjusting, and instead of bringing the work down from sheet to cup in one operation, it might need two, or even three, workings, with intermediate annealings.

Meat Roasting Brackets for Mantelpiece.—The crane and brackets illustrated by Figs. 1 to 4 are cast in metal, and the patterns are cut from ⅜-in., 3-ply fretwood. The outside sizes may be marked on the material and the designs enlarged to them by means of a pantograph. The round stiffening bar at the back end of the crane is formed by glueing a strip ⅛ in. wide and ⅛ in. thick right across each side of the plate; it should then be marked out ⅛ in. in diameter and shaped accordingly. The square shown in the bottom plan at Fig. 8 should also measure ⅛ in., the pivots at the top and bottom being ¼ in. in diameter. All the designs should be cut with a fretsaw, a little on the taper for convenience in moulding, and should be finished smooth with fret files and coated with shellac varnish. The veinings of leaves and markings of flowers, etc., should be cut with a V carving tool, so that when the castings are filed up these lines will show boldly on the brass. The hook (Fig. 5) has the side holes cut in the pattern as shown at A (Fig. 6), but the slot to pass over the crane is put in with a core, the prints to receive it being marked B (Fig. 5). The corebox, shown at Fig. 7, is simply a piece of ⅜-in. stuff with a hole 3¼ in. long and 1¼ in. wide, cut a little taper to enable the core to leave the box easily. The lugs (Fig. 9) are ¼ in. thick, with the holes a little taper and afterwards filed parallel in the casting. This is also done with the holes in the three back pieces of the crane and rod brackets. The lugs are fitted into places, the one with the square hole at the bottom, and riveted at the back after the crane is filed up and placed in position. Of course, the back pieces should be filed up and finished before any riveting is done. The bevel round the edges should also be filed. A design for knobs for the ends of the ¼-in. brass rods which the brackets will carry is shown at Fig. 10, an ordinary wood screw being used with the head partly cut away and the knob cast round it.



Meat Roasting Brackets for Mantelpiece.

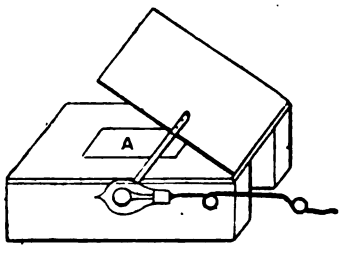
Smokeless Gunpowder.—Different kinds of smokeless powder have been tried from time to time, but have not come into general use, being more or less deliquescent, that is, they are likely to become liquid by attracting the atmospheric moisture. The so-called smokeless powder adopted in the British Service is cordite, and is so named because it is made up in strings or lengths like cord. It is a chemical compound consisting of 58 per cent. of nitro-glycerine, 37 per cent. of guncotton, and 5 per cent. of mineral jelly (vaseline). Nitro-glycerine is a mixture of nitric acid and glycerine, and forms the principal explosive agent in cordite. Guncotton is made by steeping cleansed cotton-wool in a mixture of 3 parts by weight of strong sulphuric acid and 1 part by weight of strong nitric acid. After about five minutes' thorough immersion in the acids it is taken out, and plunged into a large volume of cold water to rid it thoroughly of the acids, after which it is dried, and used as one of the component parts of cordite. Guncotton, being itself a powerful explosive, contributes to the propelling force of cordite, and also helps to contain the nitro-glycerine. Vaseline is slightly explosive; its principal use in the compound is to bind the other ingredients together. Cordite varies in colour from yellowish brown to dark brown. It is manufactured in various sizes, (1) of a specified length, and (2) of indefinite lengths. In (1) the size and length are distinguished by a fraction, the numerator of which represents the diameter (in hundredths of an inch) of the die through which the cordite is pressed, the denominator representing the lengths of the cord in inches, or the nearest whole number of inches, above the maximum length to which the cordite is cut. The following sizes have been approved, viz. $\frac{7\frac{1}{2}}{12}$, $\frac{10}{7}$, $\frac{15}{14}$, $\frac{40}{26}$, $\frac{50}{17}$. In (2) the size is distinguished only by the diameter of the die. The following sizes have been approved, viz. 40, 10, 5, and 3¼. The 3¼ size is used for howitzer and small-arm cartridges. There is also $\frac{20}{S.C.}$, which is sliced cordite made from cords of 20 diameter cut into thin wafers, for use as blank ammunition. In making up cartridges, a suitable size is selected, and the cordite is cut into the requisite lengths, made up into bundles of the required weight, and inserted into the cartridge case. In order to prevent hang-fires, it is primed with fine-grain black powder. It is absolutely smokeless. The discharge is accompanied by a very vivid flash, and by a report not louder than that given by gunpowder. There have been several unsuccessful attempts to make noiseless gunpowder.

Making Linseed-oil Varnish by Agitation.—The method of making linseed-oil varnish by agitation gives results that are not so satisfactory as the old method of running the gum by heat. The agitation process is as follows. 96 lb. of Sierra Leone copal gum are crushed fine and placed in a churn driven by steam power, together with 12 lb. of white dried copperas, 1 lb. of borate of manganese, 6 lb. of powdered litharge, and 40 gal. of American turpentine. The whole is agitated for thirty hours, after which 25 gal. of pale clarified linseed oil are added and the whole again agitated for twenty hours; then it is taken out and placed in tanks to settle. The varnish made by this process is very pale, but does not dry as hard, and is not so elastic, as varnish made by the old heat method.

Making Celluloid Rings.—It would not be advisable to bend celluloid rods into rings by heat applied from some direct flame, because the material is extremely inflammable. Celluloid may be bent after soaking it for a few minutes in boiling water, but such treatment causes the celluloid to become dull, and it would require burnishing up. Perhaps the following plan will be suitable. Set up a burnished brass or copper tube, slightly taper if possible, the outer diameter being about 1¼ in., and fit to it at one end by an adapter a small (say ¼ in.) brass pipe conveying steam from a boiler; in the same end fit a similar waste pipe to convey the steam away. This tube will serve to bend the celluloid on, and if the bend has to be an absolutely true one, slip the rings off the hot pipe on to a cooler one. Something must be devised to keep the rings in shape until they are quite cold.

Transfer Lantern Slides.—In making slides for magic lanterns, some transfers are attached to the glass by soaking with water when in position, and then slipping off the paper, nothing further being required. A good way of attaching transfers is first to coat the glass with collodion, and then to use a thin coating of gelatine as the adhesive agent. Transfer slides, as a rule, are coarse and old-fashioned looking, and have been almost entirely replaced by photographic slides. (See Series I., p. 11.)

Local Intensification and Reduction of Negatives.—Local intensification and reduction with the brush when retouching photographic negatives can be carried out in many instances very successfully, but some little manipulative skill is required on the part of the operator. The solution should be rather stronger than for ordinary intensification and reduction. Soak

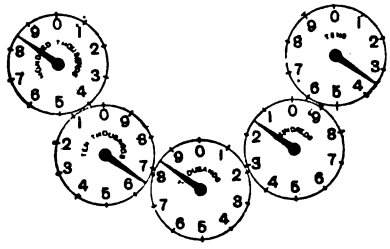


Stand for the Local Reduction of Negatives.

the negative, and, if possible, support it upon a table in such a manner that the light is thrown up from below. This is easily managed with the electric light as shown in the illustration. The opening A is filled by an old fogged dry plate, which serves to diffuse and soften the light. Portions of the negative that require treatment are placed over the opening as required. A No. 3 brush will be suitable, and a one-solution intensifier such as uranium should be used. Brush over the parts of the negative requiring alteration, and almost immediately swill under a rose tap; apply the solution again, and repeat the operation till the desired effect is obtained. Where the outlines of the treated part are sharply defined, the solution must be carefully painted over and allowed to stand for an instant before swilling. In such cases it is sometimes better to work on the dry film. Do not attempt the intensification or reduction of very fine lines, as the solution is sure to spread and make matters worse. For reduction, either the cyanide and hypo or the ammonium persulphate reducer may be used according to the result desired. The former gives greater contrast, and the latter less. The uranium intensifier may also be very successfully used as a reducer, that is, by first intensifying the whole negative, and then, with a brush charged with weak ammonia solution, touching the parts that do not require strengthening, when the intensification is instantly removed.

Removing Smell from Pipes Coated with Tar.—Pipes, as used for heating, that have been coated with tar give off when heated a very strong smell. One way of remedying the trouble is to open all the windows, and fire up well so as to get rid of all the volatile material from the tar. If this cannot be done, then it will be best to treat the pipes cold with benzene. It will be most advantageous to have the houses clear while this is being done, and keep all lights away so as to avoid any possibility of fire. Place some benzene in a pail and with this brush the pipes, allowing the excess benzene to fall into another bucket. After brushing, wipe the pipes clean with a cloth dipped in benzene. In this manner remove all the tar from the pipes, and open all the windows; next morning fire up, and in a short time the houses will be clear of fumes. A suitable wash for pipes in a greenhouse is slaked lime; or, if it is desired to have them black, use blacklead mixed with a very little gold size and sufficient turpentine to make it fluid.

Reading Gas Meters.—Gas meter manufacturers do not all adopt the same method of arranging dials, but usually in 200-light gas meters there are five dials, marked tens, hundreds, thousands, tens of thousands, and hundreds of thousands respectively. This means, that in the case of the first dial (tens) the movement of the pointer from 0 to 1 indicates the passage of 10 cub. ft. of gas, and the complete revolution of the pointer 100 cub ft. Similarly in the case of the second dial, the reading 0 to 1, or 1 to 2, indicates the passage of 100 cub. ft., and the whole circle of the dial 1000 cub. ft. of gas. Usually the dials are so arranged that the pointers do not travel in the same direction, but alternately from right to left and from left to right, the numbering on the dials being arranged accordingly. In taking the indices of such meters the usual practice is to neglect the indications below 100, but in the accompanying illustration the method of reading the whole of the dials is given. In reading an index it is usual to commence with the lowest figure. Therefore, starting with the dial on the extreme right, it will be seen that the pointer lies between the figures 3 and 4; the figure 3 is therefore recorded. Working in the direction right to left, in the next dial the pointer is between the figures 1 and 2; the figure 1 is therefore put down. In the next dial the pointer is between the figures 8 and 9, and the figure 8 is put down. In the next dial the pointer is between the figures 6 and 7, and the figure 6 is put down; while in the case of the last dial on the extreme left, the pointer



Reading Gas Meters.

being between the figures 8 and 9, the figure 8 is put down. Placing these figures in one line the meter reading is 86,813, and if the meter originally started from zero, these figures would indicate that the meter had passed 868,130 cub. ft. of gas. As the first dial indicates tens a cipher must be added to the last figure. Expressed in words, the amount of gas passed through and checked by the meter would be eight hundred and sixty-eight thousand one hundred and thirty feet; but since, as before stated, amounts less than 100 ft. are not usually dealt with, the quantity noted would be 868,100 cub. ft., that is, dealing only with four dials, and adding two ciphers to the hundreds figures. In reading indices it is necessary to note that no figure must be recorded on the register unless the pointer has passed it.

Blackening Copper and Brass.—Polished copper or brass, if held in the smoke near to the flame of burning straw, will become coated with a deposit of carbon mixed with oxide of copper. A deep black colour may be obtained on copper by immersing it in a concentrated solution of copper carbonate in liquid ammonia. A bronze-black tint is secured by immersion in a solution of barium sulphide (100 gr. in each pint of water). As these black deposits are often partially hidden by brownish or greyish salts, partially decomposed, it is advisable to brush the articles well with a soft hair brush after they have been dried. They may then be lightly burnished where bright effects are desired, and afterwards coated with transparent lacquer.

Waterproof and Translucent Paper.—A suitable solution for rendering paper translucent and waterproof may be prepared as described by the following. Take 50 oz. of pale amber resin, 45 oz. of paraffin wax, and 6 oz. of silicate of soda. Make the ingredients into a solution by heating them over a fire. The paper should be dipped in the solution whilst hot. This method renders the paper translucent and exceedingly durable when exposed to the weather. The paler the resin the more translucent is the solution.

Dumb Piano.—Dumb pianos for five-finger practice, commonly called digitoriums, are now out of date, but in appearance they resemble five ordinary piano or organ keys enclosed in a case, with springs at the back equal in pressure and corresponding in touch to those of a modern piano. Primarily, the object is to enable the would-be performer to gain facility with his fingers without the tedium of sitting down to the piano for constant practice with the accompaniment of more or less noise. There are now many contrivances to enable the performer to gain this facility, and in some modern pianos quietness is secured by the use of a silencing stop, sometimes called a sordine stop, a contrivance by means of which the celeste may be operated by the aid of a knob working in a slot cut in the blocks at the extreme end of the keyboard; it has the advantage of keeping the celeste immediately in the striking line of the hammers till such time as the knob is drawn forward again. The celeste is a strip of very soft felt, so arranged that, when operated by the left foot pedal or by the sordine stop referred to, it is brought in a line between the wires and the hammers and thus muffles the tone. A modification of the foot pedal arrangement is of American origin. It embodies the principle of harp foot pedals, which, when pressed down, are at the same moment pressed sideways into notches. Again, the Hardcastle pianoforte touch regulator is an ingenious device for lightening or increasing the touch, thus bringing the instrument to individual requirements.

Filling and Sealing Ether in Tubes.—A method of filling with ether, etc., and hermetically sealing glass tubes having a capacity of about 2 oz., is to obtain a piece of soft German glass tubing about 1 in. in diameter, and then to close one end by drawing off and sealing in the blowpipe flame; then measure into it 2 oz. of water, make a mark on the outside at the level of the liquid, then pour the water out and dry the tube. Now in the

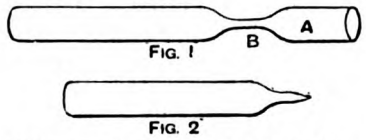


FIG. 1

FIG. 2

Filling and Sealing Ether in Tubes.

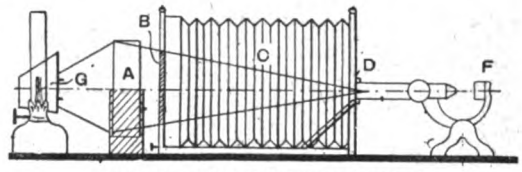
blowpipe flame heat the tube about 1 in. above the mark, rotate it, and when softened, draw out to a long, fine tube (see Fig. 1). Allow to cool, then run a little ether into the funnel A (Fig. 1). Warm the tube over a steam bath, then cool it; the ether will thus be sucked in; this may be done a few times until the ether reaches the 2 oz. mark. Now in a small flame hold the tube at B, draw it out, and it will seal off as at Fig. 2.

Refining Salt.—Salt is produced from brine by first evaporating it in the open air by flowing it over huge piles of faggots into a tank below. The solution is then heated in large shallow iron pans over naked fires until the sludge is thrown down, and the clear liquid is run into clean pans, where it is evaporated until small crystals appear on the surface. The salt then begins to deposit out and is raised to one side of the pan, from which it is removed by perforated shovels to colander baskets, in which it drains. If the coarse salt has to be refined, it must be re-dissolved in boiling water, allowed to stand till the insoluble material has separated out, then concentrated by evaporation till it begins to crystallise, run out into cooling tanks, and briskly agitated so as to bring down the salt in a fine state of division; this may be drained and dried as above. The liquid from which the salt has crystallised may be again heated, and used in dissolving fresh salt; but it will gradually become too impure to use, and should then be thrown away.

Treatment of Damp Walls.—The presence of damp on the interior of a wall requires immediate attention. There are numerous so-called remedies, which require constant renewal, and finally cost more than the initial outlay on a more satisfactory method which an expert has employed on the west coast, where the weather is excessively damp. This remedy simply consists in covering the whole of the exterior with Portland-cement stucco. It is immaterial whether the wall is built of brick or stone, but it is imperative that the sand used should be of approved quality. Sea sand is to be avoided, on account of the saline matter and moisture it contains. River sand, although smoother than pit sand, is preferable, as it is free from clayey or loamy matter. The first coat is to be used as coarse as possible in the proportion of 3 of sand to 1 of cement, with a uniform thickness of not less than ½ in. to ¾ in.; the finishing coat is to be composed of sand of a finer grain, in the proportion of 2 of sand to 1 of cement, and to be ⅛ in. to $\frac{3}{16}$ in. in thickness. To further increase the damp-resisting properties of Portland-cement stucco, it should be painted the following summer.

Paint for Porous Surfaces.—A paint as used for porous surfaces may be made as follows. Take 84 lb. of zinc white paint, 60 lb. of pale glass resin, 3 gal. of coal-tar naphtha, 2 gal. of Pratt's deodorised naphtha, and ½ gal. of albumenised linseed oil. Place the zinc white in a suitable vessel, and thin down with ½ gal. of the tar naphtha. Melt the resin in another vessel, and cool down to about 90° F., then add the naphthas very slowly, stirring all the time, and finally add the oil. If too thick, thin down to the required consistency with tar naphtha. The paint may be made in almost any colour by taking half the quantity of zinc white and replacing with any coloured pigment. For dark colours, as chocolate, etc., ordinary resin may be used, as it is not so expensive as glass resin. The paint dries hard with a brilliant gloss in four hours, and costs about one-third of the usual price to manufacture.

Micro-photography. — A micro-photograph, seen usually in a pencil case, penholder, etc., is just the opposite of a photomicrograph, and can be obtained through the agency of a microscope by reversing the process described on p. 47. That is, the negative is supported at B with a condenser at A, receiving the light from G. C is a camera, into the front (D) of which is fixed the microscope tube with eyepiece removed (or not, as required). At F is supported a small metal dark slide carrying the plate. This slide is made with a removable back, and will take a plate of exactly the same thickness and having a similar film on it on which is marked a



Apparatus for Micro-photography.

spot the size of the required reduction. This spot is set up in the slide and focussed sharply at B on a fine screen or with a magnifier. Now, without altering the adjustment, slip the negative in place of the screen, and put the plate in the slide instead of the film spot. Collodion emulsion should be used because of its fine grain; an ordinary dry plate would be too coarse and granular when enlarged. Either the wet or dry process can be used; the former is more usual. Exposure is not long, as the greater portion of the illumination at B is concentrated at D. A box should be made to fit over the back to exclude stray light. The work may be done in the evening, the light G being, of course, closed in.

Gilding Brasswork.—The best method of gilding brasswork is by gold-plating with the aid of a dynamo. Another method, and one that would not entail such an elaborate procedure as gold-plating, is to gild by amalgamation. The article to be gilded is well cleaned by boiling in a weak pickle of very dilute nitrous acid. The mercury is prepared by dissolving a quantity of it with aquafortis in a bottle. A little of this solution is rubbed on the metal with a brush, until the surface is whited over, and then the amalgam is applied. The solution of gold or gold amalgam is prepared by dissolving granulated gold in mercury, the excess of mercury being separated by straining through clean soft chamois leather. A little of the amalgam is put on the brass article that is to be gilded and well rubbed over it with a hard brush. The gold fixes itself on the brass, and when this is well covered with the amalgam, the article is placed in a furnace that has been brought up to a gentle heat. The heat drives off the mercury, leaving behind a thin layer of gold which adheres very tenaciously and may be burnished in the usual way. (See also p. 130.)

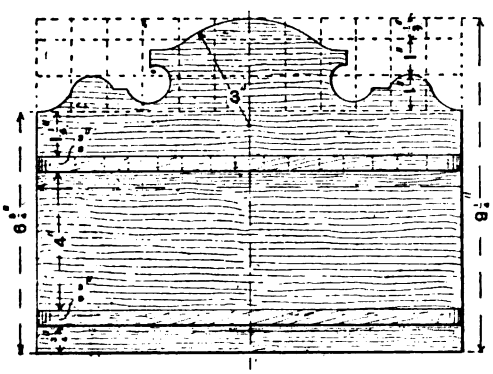
Compensation Balance Screws of Watch.—The quarter screws of a compensation balance are those used for regulating the watch and also for poising the balance. Many cheap balances have no such screws. They can be distinguished by their tops being long and not pointed like the others. Two of them will be found at the ends of the steel cross arm and two at right angles to it, the four being equally spaced round the balance rim.

Alum Crystals on Dolls in Water.—Take 8 oz. of alum and add to it 10 oz. of water; bring this to the boil, when all the alum should be dissolved. While the solution is still very hot, pour it into a jug, and in the latter place a small china doll suspended from a string in such a way that the doll is enveloped by the liquid. Allow the solution to cool, when the excess of alum will crystallise out, some on the doll, some on the sides of the jug. Place a few of the crystals in a white glass bottle or flask, fill up with the cold alum solution, and hang the doll in the liquid. Keep the bottle corked to exclude the dust.

Testing Strength of Liquid Ammonia.—To test the strength of liquid ammonia, float in it a hydrometer and note the point to which it sinks. Use a hydrometer with a scale from ·850 to 1·000 sp. gr. The strongest ammonia has a sp. gr. of about ·880 and contains about 30 per cent. of real ammonia, the rest being water. The following table gives the other strengths:—

Sp. gr.	*Ammonia.*	*Sp. gr.*	*Ammonia.*
·89 ...	27½ per cent.	·95 ...	12 per cent.
·90 ...	26¼ ,,	·96 ...	9½ ,,
·91 ...	22½ ,,	·97 ...	7 ,,
·92 ...	21 ,,	·98 ...	4½ ,,
·93 ...	18 ,,	·99 ...	2½ ,,
·94 ...	14½ ,,	1·00 ...	0 ,,

Design for a Pipe-rack.—The pipe-rack here illustrated may be made of ½-in. stuff, and mahogany will answer the purpose. The dotted squares will assist in

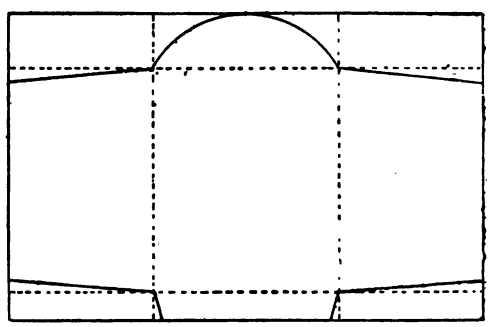


Design for a Pipe-rack.

setting out the top. Each of the two shelves is ¾ in. thick by 1¾ in. wide, the top one having ¾-in. holes (shown by dotted lines) to take the pipe stem, while the bowl rests on the bottom shelf.

Cleaning Brasswork of Bedstead.—The brasswork of a bedstead will turn black in places if the lacquer has worn off. To clean, take the bedstead to pieces, and boil the brasswork in a strong solution of common washing soda until all the lacquer is removed. The rods must be stood in the vessel containing the soda water and some of the solution poured over them. They must then be swilled in clean water to remove every trace of soda, and thoroughly dried. They are then polished with list, oil, and rottenstone. The method of procedure is as follows. Take a rod and secure it in a horizontal position about 3 ft. 6 in. from the floor. Make a paste of rottenstone and oil, and spread a little on a strip of list about 1 yd. in length. Wrap the list one complete turn and a half round the tube, take hold of the ends, one in each hand, and pull with the right and left hand alternately, keeping the list taut, and gradually pass it along the tube until all imperfections are removed. If some of the black refuses to come off, it must be removed with a fine float, and the list again used. When quite clean, wipe the rod until no grease remains, and dust it with finely powdered rottenstone. Finally, polish the rod with a fresh piece of list. The same piece of list can be used repeatedly if kept to its special operation. To renovate the knobs, etc., fix them in the lathe and clean with finest emery cloth—that used by gunmakers, etc., costing about 4d. per sheet is best—and finish with a burnisher, using thick soapsuds as a lubricant. The parts must then be swilled in clean water and dried in sawdust. Ornaments must be done either with emery cloth, which will give a matt surface, or with hand scrapers and burnishers, then washed, and dried in sawdust. Lacquering is performed as follows. Procure from a drysalter ¼ pt. of best gold amber lacquer and a camel-hair brush of not less than ¼ in. diameter. The amateur's only method of heating the rods is by steam; this can be accomplished very easily by using the kitchen kettle. If the nozzle is too large, a false one can be made of sheet tin. Get a round stick, slip it into one end of the rod, and put the other end on the kettle spout. When the rod is too hot to bear the front of the hand upon it, the lacquer must be carefully applied. The brush must not be too full or the lacquer will run in streaks; use the brush by working it backward and forward from end to end of the tube; the colour is gradually deepened by continual brushing until the desired shade is obtained. If in the first attempt the rod is spoiled, the lacquer must be washed off in soda water. The knobs, etc., can be heated on an iron plate placed over the fire, but care must be exercised or they will burn. The bedstead can be put together again by the use of pliers with washleather between the jaws.

Bag-shape Envelopes.—The bag shape of envelope is most useful for special documents, and strong cartridge paper answers for ordinary kinds; for greater strength linen-lined paper can be obtained. Procure a sheet and fold it round the matter to be enclosed, so as to produce a small lap in the middle, a small turn at the bottom, and a flap at the top. The first folding need only be roughly done to obtain the correct size of the envelope. Lay the sheet flat on the table and make the folds straight and neat; see the dotted lines in the accompanying sketch. Then with a knife and straightedge over a glass or metal plate cut out the portions marked with solid lines. Paste carefully along the edge of the narrowest side, bring over the other side, lay the



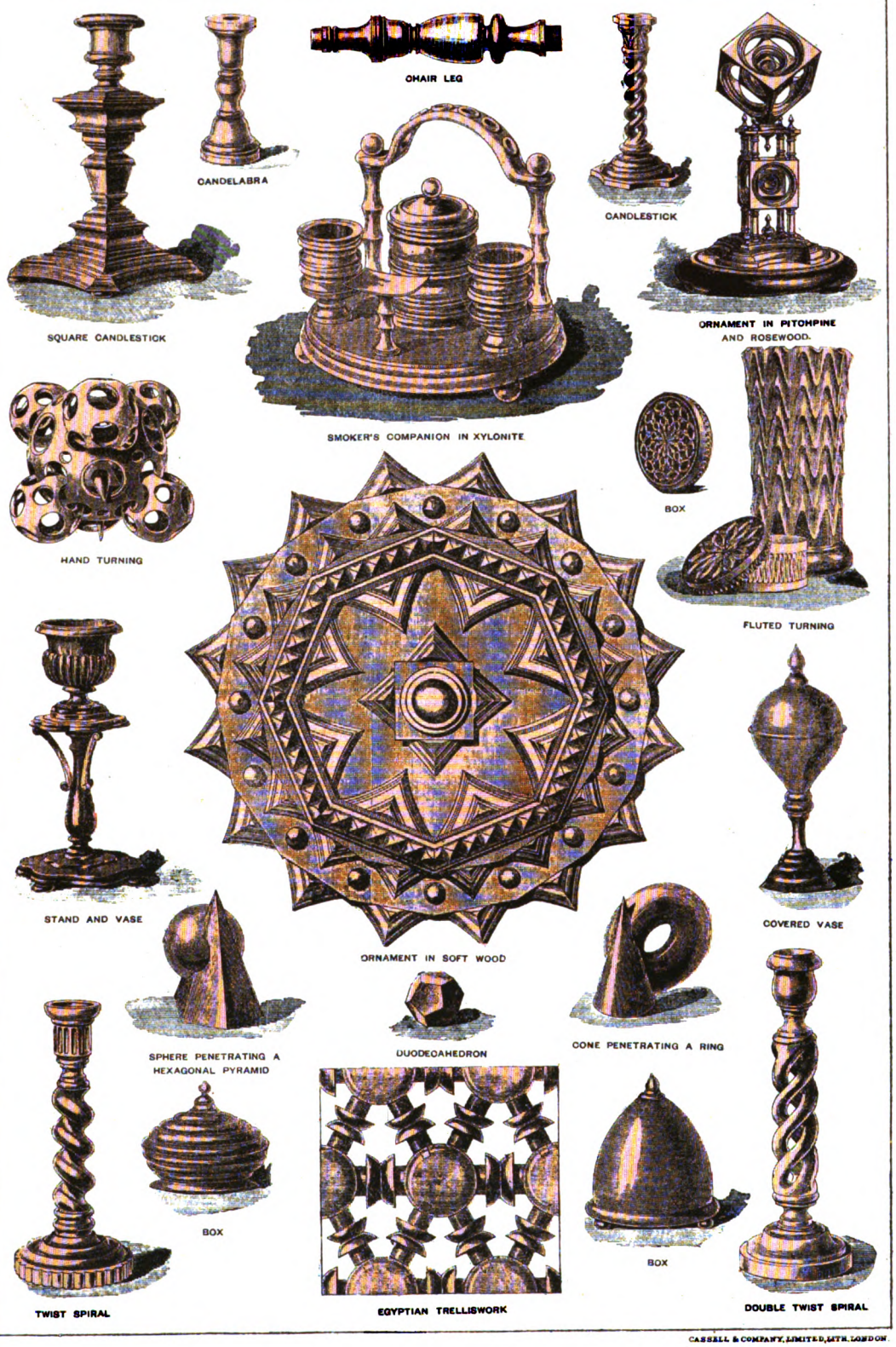
Pattern for Bag-shape Envelope.

pasted one on top, and rub down; paste the edge of the bottom and turn it up on top, rub this down and allow it to dry. The flap may be gummed or may be left to be pasted down when documents are enclosed.

Charcoal Polishing in Imitation of Ebony.—For charcoal polishing see that the wood is perfectly free from grease, glue, or marks from handling, then coat it with camphor dissolved in water; use, say, twopennyworth of camphor to ½ pt. of water. Whilst the wood is still saturated with the mixture, apply a coating of sulphate of iron and nutgalls, so that the two coatings may blend together. The sulphate of iron may be locally known as green copperas; ¼ lb. of copperas and one-pennyworth of nutgalls should be boiled together in 1½ pt. of water for at least an hour, or till reduced to 1 pt.; strain through canvas or muslin before using. The nutgalls will be better if crushed, and the mixture should be boiled in an iron vessel. When the work is dry, brush vigorously with an old scrubbing-brush or nail-brush, always working in the direction of the grain, after which rub all flat portions with stick charcoal, and mouldings or carved portions with charcoal powder. Now with a piece of soft flannel dipped alternately into a mixture of 4 parts raw linseed oil and 1 part turps, then into the powdered charcoal, well rub the work several times till the whole assumes a nice dead black colour and semi-lustrous polish. Care must be taken that the charcoal used is perfectly free from grit.

Stretching Ropes for Pulleys.—To stretch two endless 1-in. thick ropes, without loosening the splicing, so that they may be slipped over pulleys, twist them for a sufficient distance (in way of the pulleys) the opposite way to which they are wound up, so as to loosen out the strands. By this means an extra length of rope can be obtained—quite sufficient, probably, to enable them to be slipped on to the flange of the pulley.

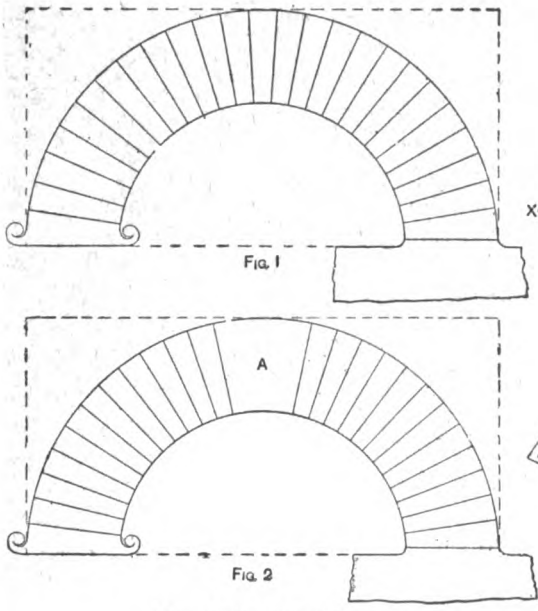
TURNERY AND LATHEWORK



CASSELL & COMPANY, LIMITED, LTD. LONDON.

Cold Supply to Cylinder becoming Hot.—A too powerful boiler is the primary cause of hot water being driven back up the cold supply of the cylinder of a domestic hot-water apparatus. One remedy is to put a secondary circulation above the cylinder so as to keep the water moving. Another remedy is to reduce the power of the boiler, either by lessening the size of the flue or by diminishing the draught. Another method is to put a check valve in the cold supply close to the cylinder, or to put a screw-down stopcock (with loose valve piece) the right way round, to form a check valve. The expansion pipe must be 1 in. or 1¼ in. according to the size of the boiler.

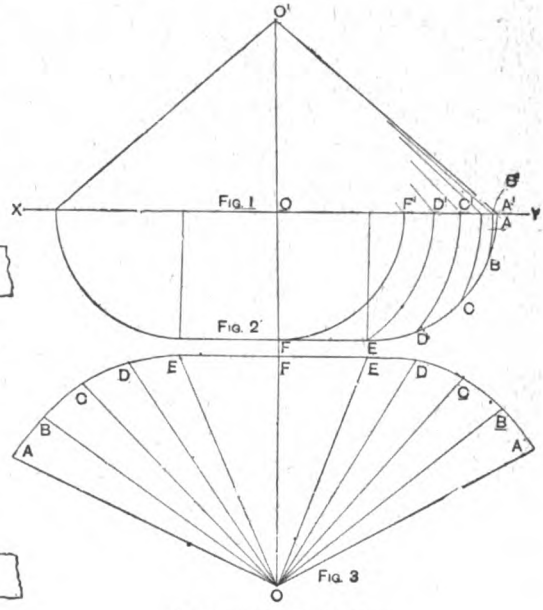
Circular Staircase.—Alternative plans are given here of a circular staircase with a handrail and balusters in a space 20 ft. by 10 ft. The height from floor to floor is assumed to be 13 ft., and the breadth of the staircase to be 4 ft. Fig. 1 is a plan of a continuous flight staircase. Upon setting out the goings along the centre of the plan, the goings will be found to be a little over 12 in., and to this a 6-in. rise will be suitable. Fig. 2 shows a landing (at A) which is very desirable to a storey of the height here proposed. In this case, if there is the same number of treads as in the staircase illustrated by Fig. 1, the going will be about 11 in. on the centre line, and this will allow of the landing A having a width of about 3 ft. on the centre line.



Plan of Circular Staircase.

Determining Magnifying Power of Microscope.—The magnifying power of an optical instrument is the ratio of the magnitude of the image produced to the magnitude of the object. Thus, the magnifying power in a compound microscope is the product of the respective magnifying powers of the object glass and of the eyepiece. Supposing the first of these magnifies twenty times, and the other ten times, the total magnifying power is $20 \times 10 = 200$. It must also be remembered that the magnifying power depends on the convexity of the object glass and of the eyepiece, as well as on the distance between the two, together with the distance of the object from the object glass. To increase the magnifying power of an instrument it is necessary to use an eyepiece of higher magnifying power, to obtain an object glass of a higher power, or both. Hence it is usual to have several eyepieces, and more than one objective with each microscope. The magnifying power is determined experimentally by means of the camera lucida or by means of a glass micrometer. The latter is a small glass plate on which has been drawn a series of lines at a distance of $\frac{1}{10}$ or $\frac{1}{100}$ of a millimetre. The micrometer is placed in front of the object glass, and as the rays emerge from the eyepiece they are reflected downwards by means of a piece of glass inclined at an angle of 45° to a scale divided into millimetres. The eye is placed above so as to see the image of the micrometer lines reflected upon the scale below. By counting the number of divisions of the scale corresponding to a certain number of lines of the image, the magnifying power is deduced. Thus, assuming the divisions on the micrometer to be in $\frac{1}{100}$ of a millimetre, if the image occupies a space of 45 millimetres on the scale and contains fifteen lines of the micrometer, the absolute magnitude of the object will be $\frac{15}{100}$ millimetre; and as the image occupies a space of 45 millimetres the magnification will be $45 \div \frac{15}{100} = 300$.

Pattern for Oval Cone.—In setting out the pattern for an oval cone first draw a semi-plan and elevation of the desired size as shown by Figs. 1 and 2. Then divide the quarter circle A E (Fig. 2) into any convenient number of equal parts, and with O (Fig. 1) as centre and radius to each of the division points F, E, D, C, and B draw arcs of circles to reach the ground line, and give the points B′, C′, D′, and F′. Join these points to the apex of the cone O′, and the lengths of these lines would be the true slants of a series of lines at equal distances apart on the surface of the cone. When drawing the cone pattern, assuming that the seams are to occur at the ends of the cone, then the pattern may be commenced by drawing two lines at right angles to each other. Take the length F E (Fig. 2) and set off F E, F E (Fig. 3), then take the true slant F′ C′ (Fig. 1) and set off as F O on the pattern. Join E O, E O to form the flat side of the pattern. Now take the true slant O′ D′ from the elevation as radius and, using O on the pattern as centre, draw an arc. With the division distance E D on the plan, Fig. 2, as radius, and E on the pattern as centre, cut the arc first drawn to give the point D. Repeat this working to give the remaining points C, B, A, using the slants in their proper order as radii, and cutting these with the division distance as explained. Arcs of circles drawn through the points A, B, C, D, and E on each end of Fig. 3 would give a half pattern. Such a pattern could be used in making up the cone in sheet metal.



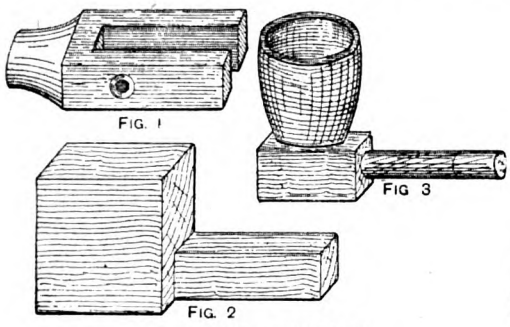
Pattern for Oval Cone.

Painting Trolley Head Board.—One of the best ways of getting up the head board of a trolley in black is to plane up the board and sandpaper well across the grain, then prime with a coat of lead colour. When dry, putty up all holes, etc., and sandpaper off, then give another coat of dark lead colour. When dry, sandpaper off and lay on a coat of drop black ground in oil. When this is dry sandpaper off lightly and give another coat, of black mixed with half its bulk of varnish, or if a very good job is desired, lay on another coat of black and then a coat of varnish. When this is thoroughly hard, flatten the surface with a pad of cloth, pumice dust and water, do all necessary writing, giving the letters two coats, and finish with a coat of varnish.

Lime Putty for Tuck Pointing.—The white putty ordinarily used for tuck pointing, or marking out the joints of brickwork with a clean-cut raised white joint, is made from pure fat limes such as are obtained from Buxton and Dorking. A small quantity of water is added to the freshly burnt lime, which then slakes, giving off steam and increasing in bulk. When the slaking is completed, more water is added until the mixture is of the consistency of thick cream, and it is then passed through a hair sieve to remove all hard lumps. The lime is now left to settle for some weeks and the water allowed to evaporate until the lime putty becomes thick enough to use. Sometimes, in order to ensure perfect slaking, the mixture will require to be kept one or two months; if not perfectly slaked, the putty will in course of time fall out of the joints. No hair must be mixed with the putty.

Paint for Grave Headboards.—To make a paint for wooden headboards for graves, take 7 lb. of dry carbon black, 1 lb. of powdered blacklead, 6 lb. of japanners' gold size, 5 lb. of albumenised oil, and 9 lb. of boiled linseed oil. Mix thoroughly together, and thin down with American turpentine. The above will be found to have strong staining powers, and will stand all weathers.

Wooden Tobacco Pipes.—Wooden tobacco pipes are made by partly turning them in a lathe, and finishing by hand. They are held in a spring chuck (Fig. 1); this is made of boxwood, one end being screwed on the nose of the mandrel and the other end forming a fork, the two sides of which can be tightened by means of a screw



Wooden Tobacco Pipes.

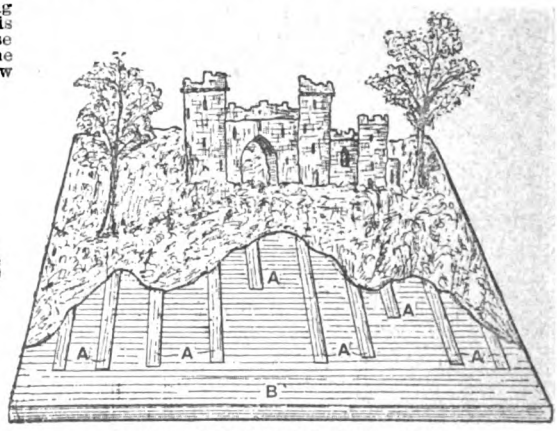
passing through them; the slot may be about 2 in. wide. The wood is cut to the form shown by Fig. 2, and is inserted in the jaws of the chuck, the bowl being turned and hollowed. It is then reversed, and the stem is turned and bored with a shell or half-round bit, the outer end being turned down and a hoop of white metal or silver fixed upon it. The hole is enlarged, and, if required, is tapped, so that the mouthpiece may screw into it, or it may be tapered and the mouthpiece pushed in. Mouthpieces of various shapes can be purchased at a small cost. After the turning is completed the pipe will be similar to Fig. 3, when the portion remaining at the bottom of the bowl can be cut off with chisel and rasp, and finished smooth.

Filing up Clock Escape-wheel Teeth.—The advancing side of the 'scape-wheel teeth of a recoil escapement clock is curved; the other sides are straight. File up the curved sides only, and be careful not to go beyond the point, or the teeth will be shortened. A file may be just lightly passed over the straight sides to make sure that there are no burrs. In a straight-tooth wheel, file the backs of the teeth only.

Resin Varnish.—For resin varnish take 60 lb. of pale amber resin, 6 lb. of thick albumenised oil, ½ lb. of newly slaked lime, and 8 gal. of American turpentine. Melt the resin and, after cooling, add the lime and oil, and finally thin down with turps, constantly stirring. Care should be taken, so as to prevent combustion, not to add the turps before the resin is somewhat cooled. The varnish should be allowed to settle fourteen days before it is used.

Glasspaper, Sandpaper, and Emery Cloth.—In the manufacture of glasspaper, pieces of broken glass are washed to remove dirt, and are then crushed under revolving stones. The crushed powder is then sifted through different-sized sieves into about six degrees of fineness. The sheets of paper to be used are covered with a thin coating of glue. The powdered glass is then taken (according to the fineness of glasspaper required), placed in a sieve, and shaken over the glued surface of the paper so as to get an even layer. Any superfluous powder can be shaken off after the glue has dried. Sandpaper is made in a similar manner, except that generally the sand does not require crushing. Emery cloth is also similarly made, with the difference that the emery, being so hard and having great cohesion between its particles, has to be crushed by concussion instead of under rollers.

Cardboard Model of Ruined Castle.—A cardboard model of a castle in ruins will require as materials, stout brown paper, cardboard, thick and thin wire, and paste. To make the latter, mix some best flour into a stiff paste with cold water, beating the mixture well until there are no lumps, then pour on boiling water; place it on the fire and bring to the boil, stirring into it some liquid glue. Now tear the brown paper into pieces about 3 in. square, and let them soak in cold water. If the model is to represent a hilly country, procure some pieces of wood A (see sketch) about 1 in. square and of different lengths, the longest being for the high parts, the short lengths for the lower parts. Fit these pieces firmly to the board B in the desired position. Now cover the whole with a sheet of cardboard, pressing it



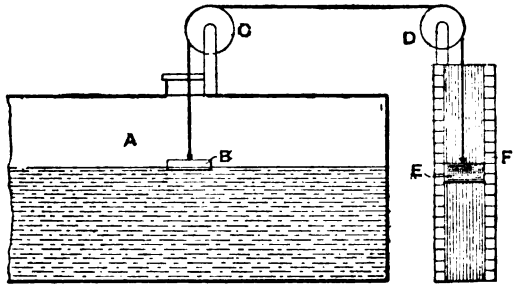
Cardboard Model of Castle in Ruins.

down between the pieces of wood forming the hills and dales, and securing it with tin tacks; also glue the edges down. Now remove the brown paper from the water, squeeze out the superfluous moisture, and paste each piece thickly on both sides, placing them one on the other to keep them moist; then lay them, piece by piece, on the cardboard model until the latter is entirely covered. Press the paper down until a fairly level and solid surface is obtained, and allow to dry thoroughly; this forms the ground to work on. Now cut out the cardboard castle, stick it together, then cover it with the brown paper and fix it on the model. For grass use a rough piece of green baize. With a sharp knife shave off the fluff from those parts that are to represent grass, brush the model over with thin glue, then sprinkle on the fluff; the ground or gravel can be represented by sprinkling on fine sand. The ruins may be prepared in a similar way, or may be painted with dry colours mixed with glue as a medium. The skeletons of the trees can be made with wire; for the trunks and branches, twist some tow round the wire with glue; when partly dry, press down with the fingers into the desired form. For the foliage, use artificial moss. Grasses and mosses may be purchased at fancy shops.

Tele-photo Lens.—In a tele-photo lens as used by photographers the image first formed by the positive or convex lens is received by a concave or negative lens which widens out the rays again, thus enabling a large image to be taken with a short extension of camera. A makeshift arrangement may be made by mounting in a tube, 2½ in. apart, a positive lens of 5-in. focus and a negative lens of 2½-in. focus. This will give an equivalent focus of 50 in., or a magnification of 4 with a camera extension of 7½ in. Of course, the work of making a high-class tele-photo lens is quite outside the capabilities of even a clever amateur, but interesting work may be done with the arrangement described above. If uncorrected lenses are used, the difference between chemical and visual foci must be carefully ascertained and allowed for.

Viewing Microscopic Objects.—The condensing lens is a microscope accessory used for the illumination of opaque objects. Being universal-jointed, the lens can be brought into any desired position to give proper illumination. When the object under observation is translucent the reflector below the instrument is put into use. Between the reflector and the stage there is sometimes attached a diaphragm or stop. This is a piece of brass perforated with four or more holes of different sizes, any one of which can be placed directly under the hole in the stage. Thus the light reflected upon the object can be regulated at will. The majority of microscopic objects are translucent because of their tenuity, and to render this quality the more perfect they are placed on slips of glass and saturated with a drop of pure water if intended merely for temporary inspection, or with Canada balsam if intended to be preserved as permanent objects. Each is next covered with a similar piece of very thin glass made expressly for the purpose, the thickness in some cases not exceeding $\frac{1}{100}$ in. This suffices for objects prepared for temporary inspection. Permanent objects, however, are fixed in place by gumming paper round the slips of glass, so as to envelop them completely; but previously cut out a small circular piece from each side of the glass, and in the centre of it where the object is placed. (See also Series I., pp. 73 and 133).

Indicating Amount of Liquid in Tank.—To indicate the amount of liquid in an oil or other tank A (see illustration) at any time, a hollow float B may be made of sheet copper, weighted with shot, and attached



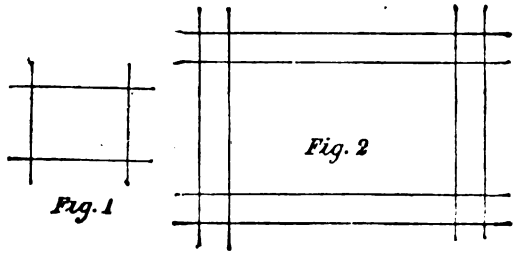
Indicating Amount of Liquid in Tank.

to a stout cord passing over a pulley C directly over the hole. The cord passes over a second pulley D, and is attached to a flat weight E, which just counterbalances the float when it is on the surface of the water. The weight slides in a groove on the board F, outside the tank, and the measurements are marked upon the board. A glance at the position of the weight shows at once the amount of liquid in the tank.

Removing Spindles from Mangle Rollers.—To facilitate the removal of spindles from old mangle rollers, the wood should be shrunk by the application of heat. The spindles may then be driven out from one end of the rollers, care being taken that the spindle ends are not burred over. If the old rollers are useless, of course the quickest way will be to split the wood off. In fitting the old spindles to new rollers, the spindles being $1\frac{1}{16}$ in. in diameter, and the holes in the new rollers only $\frac{7}{8}$ in., the hole will have to be enlarged, for which purpose obtain a hand auger; a 1-in. auger will probably be sufficiently large. Great care will be necessary to start the auger at each end, so as to make the hole concentric with the outside. Probably the easiest way will be first to make the hole at each end slightly over $1\frac{1}{16}$ in. by using a reamer; this will be found to make a good start for the auger, with which the hole is completed. The spindles may then be fitted into the holes.

Distinguishing Mahogany.—Spanish, Honduras, and bay mahogany are all three produced by the true mahogany tree, *Swietenia Mahagoni, L.* The distinguishing names were originally given in reference to the localities from which the wood was principally shipped. Thus, Spanish mahogany came from Cuba and some other West Indian islands and ports belonging to Spain; Honduras mahogany came from the province of Honduras in Central America—chiefly from the neighbourhood of the mouth of the Rio Hondo; while baywood or bay mahogany was obtained from various places around the coast of the bay of Honduras. The mahogany procured from these three districts varied considerably in colour, in hardness, and in figure—the Spanish wood being much the best and the baywood the poorest. Now, of course, mahogany wood is obtained from many other districts and ports in Central America, as, for example, Tabasco, Minatitlan, Tecolutla, Panama, Costa Rica, and St. Domingo, but to the average wood-worker in England only three grades still exist, namely, Spanish, Honduras, and baywood, chiefly because each of these three names has come to represent an arbitrary standard of quality, colour, and figure, regardless of the origin. Beyond saying that the baywood is the soft, light, straight-grained, and pinkish (nearly white) material, and that the Spanish is the dark, ruddy-brown, often cross-grained, and curly wood, no definite rule can be given; observation will soon disclose the ordinary limits of each term. Some regard the chalky deposit in the pores of dark-coloured mahogany as conclusive evidence that the wood is of Spanish origin, but the occurrence of this substance is by no means an infallible test.

Setting Out Buildings.—The method of setting out a building on the ground very much depends on the size of the building and the nature of the ground. In important work it is necessary to employ a theodolite, but in common work a few strings and pegs are all that are required. The lines should always run beyond the net limits, as, for instance, Fig. 1, representing the lines for a rectangular pier, and Fig. 2, showing wall trenches. In general building the first thing will be to sight through to obtain the frontage line, then to range a line at right angles for the flank wall, and afterwards to put in the other lines parallel with the lines already obtained. To get a right angle, a large framed set-square, such as is found in various departments on a building, or a cross staff, or an optical square, may be used, or advantage may be taken of the property of a triangle whose sides



Setting Out Buildings.

are in the proportion of 3, 4, and 5, namely, that the angle between the sides 3 and 4 will be a true right angle. In any rectangular outline such as Fig. 1, a check upon the accuracy, beyond seeing that the opposite sides are equal, is to see that the two diagonals are also equal.

Length of Clock Pendulum.—In calculating the length required for a clock pendulum, first ascertain how many beats the pendulum will have to make per minute. To do this, count the teeth of the centre and all other wheels up to the 'scape wheel. Multiply these together and divide the result by all the pinions from the centre wheel onward, leaving out the centre pinion. This doubled will give the number of beats per hour. Divided by 60 gives the number per minute. This number generally lies between 60 and 180. To find the length of the pendulum to give the required number of vibrations per minute, make a proportion sum, calculating from the length of the seconds pendulum, 39 in. (about). Thus (Required number of beats)^2 : 60^2 :: 39 in. : required length. If 120 be the number of beats, then $120^2 : 60^2 :: 39$ in. : required length; which, of course, equals 14,400 : 3,600 :: 39 in. : 9¾ in.

Gilding Picture Mounts.—The bevelled edges of picture mounts are often neatly covered with thin gilt paper. To gild mounts with gold leaf is rather an awkward job for an amateur, but the following is the method of procedure. Rub down the edge smoothly with a bone paper-knife or tooth-brush handle, then paint carefully with Young's patent size, using a camel-hair pencil, and allow to dry. Have at hand some gold leaf cut in strips; also some size prepared with white of egg beaten to a thick froth with double its quantity of water. Now with a camel-hair pencil paint one of the four sides; this must be done at one swift sweep of the brush. While the side is still wet, lift up strip by strip of gold and lay them down gently, taking care that they are flat. When the four sides have been done, allow the whole to become perfectly dry; then burnish with an agate burnisher.

Repairing Melodeon Reeds.—In riveting fresh tongues to melodeon reeds, brass wire, or the small brass "rivets" used by shoemakers, may be used. See that these fit the hole, and, before hammering, be sure that the tongue fits the opening in the plate without touching or without too much clearance. Tuning is done by reducing at the rivet end to flatten, and at the free end to sharpen, but select a tongue as near the pitch as possible before closing the rivet tight.

Waterwheel Sluice.—Below is described a method (workable from the wheelhouse) of stopping the flow of water in a pipe used with a waterwheel. Assuming that the mouth of the pipe at the dam is not flush with the stonework, but is recessed about 12 in., the simplest way to stop the flow of water would be to build a small chamber of brickwork set in cement behind the masonry dam, as shown in Fig. 1. Over the mouth of the pipe leading to the wheel arrange a flap valve A. At the lower part is an eye B, to which is fastened a small chain. This chain passes over the two pulley wheels C to the ratchet windlass D, placed in the wheelhouse. Sufficient chain only will be required to pass over the

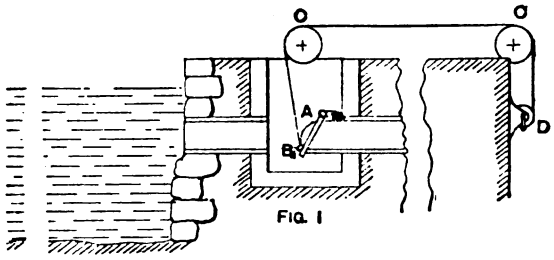


FIG. 1

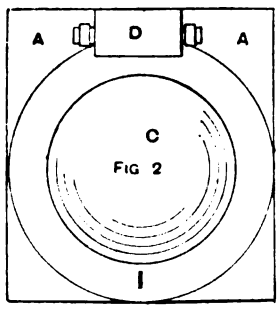


FIG 2

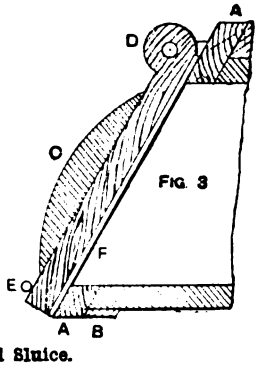


FIG. 3

Waterwheel Sluice.

pulleys and windlass; a length of galvanised wire can be used between the pulleys. Figs. 2 and 3 show a front and sectional view of the valve, which is made of 1-in. green elm. To construct the valve, cut two squares sufficiently large to leave 1½ in. outside the diameter of the pipe on each side. Cut a 6-in. circle in the centre of one piece, and in the other piece cut a circle sufficiently large to pass over the clay pipe at the angle shown. Fasten the two squares together as shown in section at A B (Fig. 3) with copper or zinc nails. The valve should be 2 in. larger in diameter than the hole in the piece A (Fig. 3). Cover the face of the valve with leather, and at F on the outside secure a piece of lead C. The valve is hinged to the boards by a joint D, which should be rather loose to enable the water to press the valve even on the face of the outer wood piece so as to form a perfectly watertight joint. At the bottom of the valve is the small brass eye E (Fig. 3). To stop the water flowing, the valve is allowed to drop; to allow the water to flow, the valve is lifted by winding the chain on the drum of the windlass in the wheelhouse. It will be advisable to put a grating at the mouth of the pipe in the dam to prevent debris passing into the pipe.

Canvas and Colours for Transparent Painting.—For transparent painting, white union prepared with varnish is employed. To make the varnish, dissolve white wax in oil of turpentine in the proportion of about 2 oz. of the former to half a pint of the latter. Place this in a galley-pot, and dissolve by gentle heat in the oven; be sure not to place it on the fire. When dissolved, strain through muslin. Apply the varnish evenly over the union, and allow to dry; it is then ready for painting on. To make transparent gold colour for application to the prepared canvas, pound separately 2 oz. of stick-lac, 2 oz. of gamboge, 2 oz. of dragon's blood, 2 oz. of arnotto, and ½ oz. of saffron. Place these separately into a pint of alcohol, and expose to the sun for three days in a narrow-mouthed bottle; or keep them in a very warm room, shaking them every now and then to hasten the solution. When all the ingredients are dissolved, mix them together, and strain through muslin. For a green colour get a tube of Antwerp blue oil colour, and add a portion of this to the gold. The quantity of blue to be added will depend on the depth of green required.

Wire Frames for Hanging Plates and Dishes.—Fig. 1 shows a wire frame for an ordinary china plate to be hung against a wall. To make the frame, two pieces

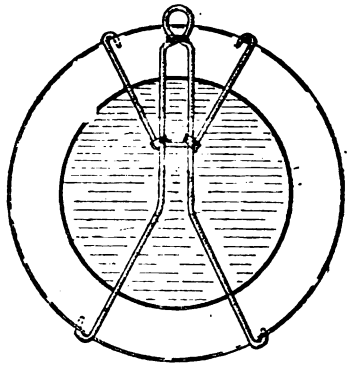


FIG 1

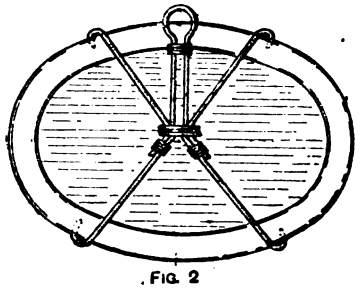


FIG. 2

Wire Frames for Hanging Plates and Dishes.

of wire are fastened together with binding wire as shown. This wire, turned up at the ends, may be sprung on to the back of the plate. Tinned wire of No. 15 or 16 gauge should be used. Fig. 2 shows a similar arrangement to Fig. 1, but suitable for an oval dish.

Causes of Spilly Casting.—Spilly casting generally is due to dirt in working and carelessness on the part of the pourer. Having an alloy composed of 63 parts of copper, 72 parts of brass scrap, and 23 parts of spelter, with attention to the following directions very little spill need be made. The ingots must be thoroughly cleaned each time, first by scraping with a sharp-edged tool, and finally with a stiff wire brush; the brush polishes the ingots quite smooth. The ingots should now be covered with an oil and resin preparation, just sufficient resin being boiled with the oil to make the preparation slightly sticky. Dust the ingots over with powdered charcoal and blow off any surplus; this is most important. When the metal is thoroughly melted, well stir; this gives an opportunity for impurities in the metal to rise to the surface and prepare for fluxing. Make up a flux of common salt, borax, powdered glass, charcoal, and oil to form a paste; the quantities used vary according to the nature of the metal and the dirtiness or otherwise of the scrap. Roll about 6 oz. of this paste into a ball and place it in the molten metal, mixing vigorously to remove all oxides, dross, dirt, and other impurities. When pouring, see that all scum is well kept back by the skimmer from passing into the ingot, when strips very free from spill should result.

Grain Rising during French Polishing.—The rising of the grain after the wood is filled in is due to excessive moisture. Either the polish used is too thin in body or the polish pad is too saturated at the commencement. Try the effect of passing the polish rubber straight from end to end before working it circular, and, to ensure a dry foundation, work the first pad out fairly dry before applying more polish. If this does not prove a success, add more shellac to the polish. Should the rubber have a tendency to drag, which will also cause a roughness, touch the face with a few spots of linseed oil.

Skylight to a Roof.—Say that a skylight 30 ft. by 6 ft. is to be fixed in a roof, and two parts (4 ft. and 6 ft.) are to open. Fig. 1 shows a section through a roof light together with the opening light and the curb necessary to make it watertight. The curb is tongued at the top and bottom edges; the double line on the outside shows 5-lb. lead flashing. Fig. 2 is a transverse section through the same lights showing also the finish to the ridge and the lower curb where it comes into contact with the roof rafters and slating. The opening light is fitted with an iron quadrant opener and a framed pulley fixed on the curb. The two details are self-explanatory. The letter references to the illustrations are A, iron quadrant; B, framed pulley; C, hinged joint; D, slates on roof; E, wood rafter; F, plaster ceiling; G, curb; H, ridge.

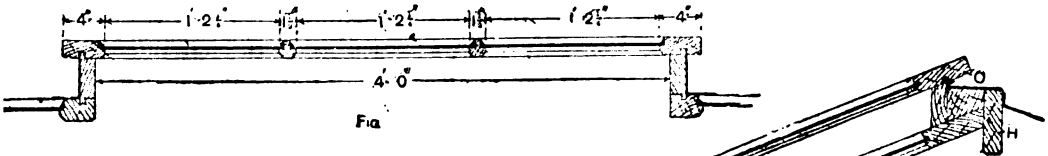


Fig. 1

Fig. 2

Skylight to Roof.

Chemical Experiments with Optical Lantern.—For chemical experiments to be projected by a lantern upon a screen, a glass tank such as is illustrated on p. 61, Series I., is desirable; this is of such a width that it can be inserted in the slide stage in the place of the usual carrier; the slide stage must be open at the top. For lantern experiments in physical science, etc., a demonstrator's lantern is generally necessary; this has an open space between the condenser lens and the objective lens, instead of the usual draw tubes, and there is a little table to support the apparatus which is to be projected. An ordinary lantern may be converted with but very little trouble to a demonstrator's lantern by removing the draw tubes and supporting the objective lens in a sliding frame. Chemical reactions are shown very easily in an ordinary lantern having an open slide stage. The trough is nearly filled with a solution, and the re-agent introduced by means of a small funnel or pipette, neither of which, however, is allowed to dip into the solution, except in particular cases. Good effects are obtained if the re-agent falls in drop by drop. As a guide to suitable experiments with re-agents, the following notes are given. The liquid with which the tank is to be filled is the one first mentioned. (1) Solution, sulphate of zinc; add ammonia to produce peculiar steel grey precipitate. (2) Solution, sulphate of copper; add ferro-cyanide to produce reddish-brown liquid. (3) Solution, sulphate of peroxide of iron; add solution of ferro-cyanide of potash to produce Prussian blue. (4) Solution, indigo and a little sulphuric acid; add solution of bleaching powder (chloride of lime) to decolorise the solution. (5) Solution, chlorate of barium; add dilute sulphuric acid to precipitate fine granules of sulphate of baryta. (6) Solution (20 per cent.), nitrate of lead; add crystal of sal-ammoniac to produce curious floriations of lead chloride. (7) Tincture of blue turnsol; pour in jets of dilute sulphuric acid to give red colour; then add ammonia to restore blue colour. (8) Solution (very dilute), nitrate of silver; add solution of sea-salt or chloride of sodium to produce snow-like precipitate of silver chloride. (9) Suspend crystal of oxalic acid in trough of hard water (water containing lime); threads of oxalate of lime grow from the crystal. (10) Solution, sulphate of copper; change blue colour to green by adding ammonia; add more ammonia to dissolve precipitate and to give a sky-blue colour. (11) Any aniline solution; change colour by adding alkali, and change again with acid. For example, solution of rosaniline; add ammonia to change the colour, and restore colour with sulphuric acid or, preferably, vinegar. The following experiments are intended to illustrate the mixture and diffusion of liquids. The trough is to be filled with the liquid whose name is given first. (1) Pure water; add to the surface a drop of milk, and vortex rings form. (2) Pure water; introduce from bottom some coloured alcohol or wine; there is gentle diffusion. (3) Alum solution; introduce at the bottom an alcoholic aniline solution to form curious shapes. (4) Pure water; place crystal of aniline violet on surface, and fine threads of violet solution will fall and spirals form. (5) Lukewarm water (from 60° F. to 68° F.); float a small piece of ice on the surface, and the mingling of the two liquids of different densities causes forms and figures. (6) Methylated spirit or pure alcohol; add to side of trough a drop of alcohol coloured with aniline dye; branches of coloured solution immediately form. (7) Pure water; add minute drop of coloured liquid, say ink to form spirals, which break and form other spirals, and rings or convolutions also form. Below are notes on various experiments, not necessarily chemical, that are effective. As above, the trough is filled with the liquid which is mentioned first. (1) Concentrated solution of hydro-chlorate of ammonia; lower into it an amalgam of mercury and sodium; ammoniacal gas bubbles up, and the amalgam swells up, forming ammonia. (2) Warm and strong solution of sulphate of soda in beer; with a pipette pour this on to one of the sides of the trough, spreading the liquid well; foliage-like figures form, resembling frost on window panes. (3) Pure water; put into a glass spoon some chlorate of potash, and above that a little piece of yellow phosphorus; on immersing the spoon and adding, by means of a funnel, some pure sulphuric acid, the phosphorus ignites and shoots out sparks. (4) Glycerine; sprinkle in iron filings, which descend to the centre; introduce ends of electro-magnet and energise it immediately the filings come to rest, when the magnetism causes a spectrum arrangement; interrupt the current occasionally. (5) Coat glass plate with saturated solutions of chemical salts; the heat evaporates the moisture, leaving crystalline formations; saturated solutions of sal-ammoniac and of urea (the latter in alcohol) answer splendidly. (6) A mixture of equal parts of glycerine and a filtered solution of common soap in pure water (1 in 40); use only a little of the mixture, and blow bubbles in trough by means of a glass tube; external cells are spherical, and the interior cells hexagonal; the cells show all the prismatic colours. Aquatic insects, such as water fleas and small beetles, can be put into the tank or trough, and their movements then studied on the screen. It is hardly necessary to add that actions within the chemical tank are reversed on the screen, precipitates rising instead of falling, and air bubbles falling instead of rising; a movement of an insect in the tank from right to left appears on the screen to be from left to right.

Cementing Felt to Leather.—To cement felt to leather, if the heat to be withstood is not great, use a solution of shellac. To make this, take 1 part of orange shellac, and to it add 2 parts of methylated spirit, stirring till the whole becomes a paste; more spirit may then be added until a thick fluid is obtained. This material may be spread with a stiff brush upon the leather, and then left exposed for a short time until it becomes "tacky," when the felt may be pressed on. After a time the cement becomes very hard.

Bamboo Wall Mirrors.—The illustrations show wall mirrors in bamboo, 3 ft. high and 2 ft. 3 in. wide, made chiefly from 1-in. cane. In Fig. 1 the two stiles A are 3 ft. long, connected by four rails B 2 ft. 2 in. long, each pair being at distances of 3½ in. and 7 in. respectively from the extremities, measuring to the centre of the canes. The two inner rails B are connected, at distances of 5 in. from the stiles A, by two stiles C, 1 ft. 10 in. long, thus forming a centre frame for the mirror. The stiles A and C are connected by short pieces 5 in. long, midway between the rails B. Four pieces, about 5 in. long, projecting from the stiles A and C, and connected by a suitable rail in front, form small shelves. They are strengthened by short pieces fixed underneath. Two panels, either lacquered or of Japanese paper, are fixed at each side of the mirror, and the top shelf is made from bent cane. The top part D is made from a horizontal piece 1 ft. 7 in. long, and three short pieces 3 in. long; the filling at the top and the bottom is of ⅜-in. cane. In Fig. 2, the dimensions for the rails and stiles A, B, and C are similar to Fig. 1, the addition being four pieces about 1 ft. 1 in. long, forming a diamond frame for the mirror. A long panel is fixed at the bottom and a lower shelf E is added as shown. Triangular panels are fixed at each side of the mirror.

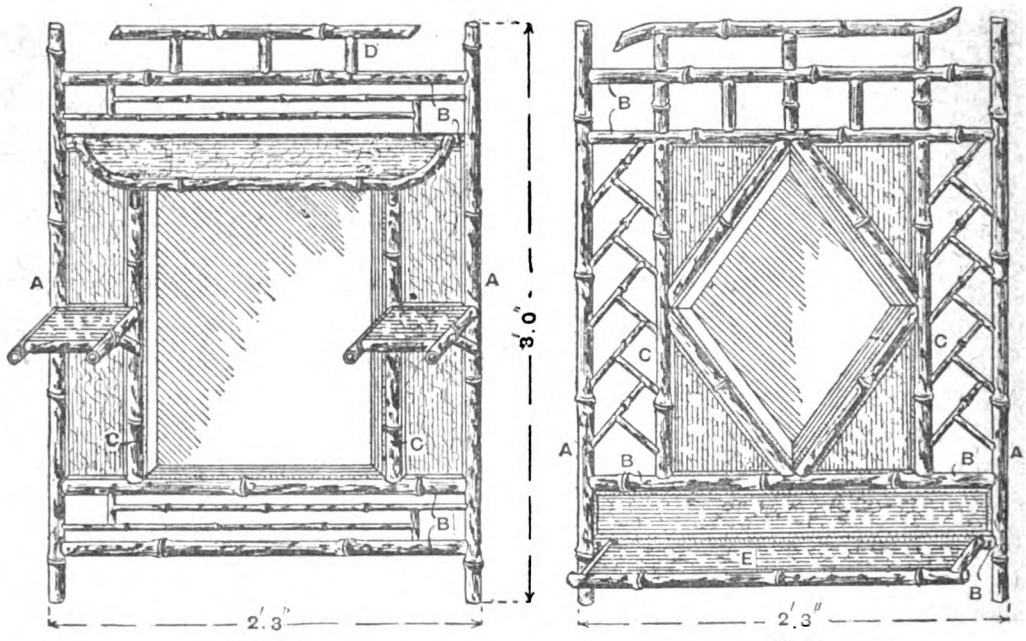


FIG. 1 FIG. 2

Bamboo Wall Mirrors.

Cleaning Pictures and Mounts.—The usual method of cleaning mounts is with bread crumbs or soft indiarubber. The most desirable alternative way, where possible, is to have the picture re-mounted entirely. A picture that is merely incrusted with dust may be cleaned by laying over it a damp cloth for an hour or so and repeating the process, using a clean cloth every time till all the dirt has been soaked out. The picture may then be treated with a thin coat of mastic varnish. If the picture is old and valuable, and it is desired to remove the varnish, those in the trade do so by continual rubbing with the fingers, taking off the varnish in little crumbs. But this is a very long and tedious operation. Turpentine, a weak solution of ammonia or alcohol, or methylated spirit may be used to soften the varnish, which is then carefully rubbed off. Great care is necessary when using these solvents to prevent them attacking the paint. Have some water at hand, and apply immediately the paint seems affected.

Photographing Snow Scenes.—The principal thing to be aimed at in snow pictures is brightness of contrast with soft detail in the lights, and this can only be obtained by correct exposure. A very large percentage of snow scenes are over-exposed; the snow has consequently a dirty appearance, and the scene entirely loses its character. Nevertheless, much under-exposure will bring about the same result. The usual exposure rule (that is, expose for the shadows, etc.) may generally, in the case of snow pictures, be reversed; expose for the lights and let the shadows take care of themselves may be safely taken as the rule for snow photography. But the sensitive plate that will properly render the soft delicate gradation in the snow and the detail in the deep shadows has not yet been produced, and the operator is largely dependent on his own skill. Warm-tone papers such as gelatino-chloride are undesirable for prints of snow pictures; only platinum, bromide, or engraving black carbon should be employed.

Band Saw Breaking.—A band saw running on three wheels frequently breaks if attention is not paid to certain points. Immediately on finishing with the band saw, the strain should be taken off by lowering the top saw-wheel. While passing through the timber the saw naturally expands a little. When the sawing ceases, the saw blade contracts, and if the saw remains strained it is apt to flaw, and, when re-started, snaps. Previous to starting the saw, properly strain it; place one hand on one arm of the top wheel, and with the other hand gently pull the driving belt on the tight pulley; as the saw-wheels are about to move, assist the top wheel with the hand. This will lessen the strain on the saw on starting it. As the saw nears the end of a cut, gradually slacken the feed speed. If the saw leaves the cut suddenly, it is liable to flaw and snap on entering the next cut.

Preserving Starfish.—In addition to the methods detailed on p. 76, starfish can be preserved indefinitely without changing colour by placing them in several changes of fresh water to remove the salt, and then keeping them in spirit of wine. Or the fish might be kept in a saturated solution of common salt, which is a very different material from sea-water. A useful liquid for the purpose of preserving soft animals is produced by dissolving 4 parts of common salt and 1 part of alum in the least possible quantity of water.

Transparent Varnish for Wall-paper.—A fine clear and transparent varnish for delicate wall-papers is made of gum sandarach 2½ oz., camphor ¼ dr., rectified spirit of wine ½ pt., Canada balsam 2 oz. Crush the gum and camphor to a powder, place in a stoppered bottle, and then add the spirits of wine and agitate for several days until the contents of the bottle are dissolved. Then add the Canada balsam, mix thoroughly together, allow to settle, and the clear portion, when decanted off, is ready for use. The bottle should be well stoppered to prevent the evaporation of the alcohol. Before applying this varnish the paper should receive a coat of size, which is made by pouring boiling water upon gelatine size. When the size has thoroughly dried into the paper, one coat of the varnish may be applied with a wide camel-hair brush. The room where the varnish is applied must be at a temperature of not less than 65° F., otherwise the varnish will have a dull surface. (See also p. 135 and Series I., pp. 137 and 291.)

Lean-to Fowl House.—Fig. 1 gives a general view of a house to accommodate about eight chickens, and Fig. 2 a section lengthways showing an outside nesting box. The house is 4 ft. long, 3 ft. wide, 5 ft. 6 in. high in the front, and 4 ft. 9 in. at the back. The floor is kept 2 ft. above the ground to provide a dry run for the fowls in wet weather, but if other accommodation is available, this may be dispensed with and the house kept 2 ft. lower. The house may be built of 2½-in. by 2-in. framing covered with ¾-in. matchboarding, with 1-in. boarding for the floor. A ledged door is provided at one end, and

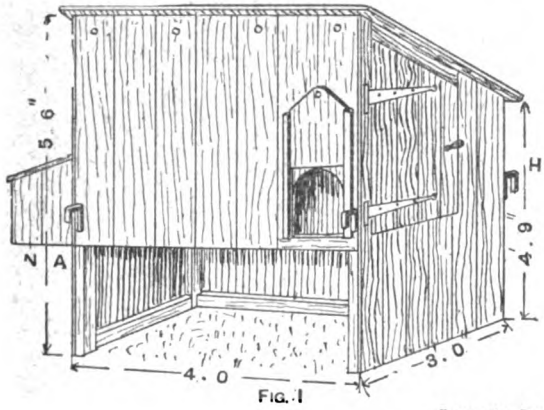


FIG. 1

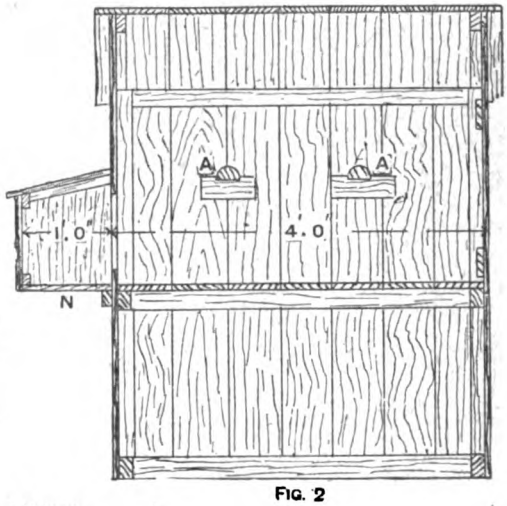


FIG. 2

Lean-to Fowl House.

the nesting box N (Figs. 1 and 2) may run the full width of the other end and be divided by matchboard partitions into three parts. The boxes may open either at the top outside or in front. Two perches may be placed in the position shown at A (Fig. 2); these can be made by sawing a 2½-in. diameter pole through the middle. It is hardly worth while to make such a small house to bolt together, as by screwing four hooks at the corners as shown at H (Fig. 1), through which two rails could be placed, the house could easily be carried by two persons.

Paper-mâché Masks.—To make a mask, use a wooden box 1 ft. square and 8 in. deep. Mix together, dry, equal quantities of whiting and plaster-of-Paris, and then make it into a thin paste with cold water. With this fill the box and allow it to dry thoroughly. Then, with a pointed knife, dig out the centre of the composition, cutting and forming the features of the mask; scrape and clean the mould quite smooth, and when this is satisfactorily finished paint it over with shellac varnish. Next make some good flour paste, adding a little liquid glue. Tear some stout brown paper into pieces about 3 in. square, put these to soak in cold water, and then squeeze all the superfluous water out of them. Well paste each piece on both sides, and place them one on the other to keep them moist. Next rub over a piece of tissue paper with sweet oil, and place this inside the mould, pressing it into the features. Press the pieces of pasted brown paper piece by piece well into the mould, building the mask up to the top edge. Continue this until three or four thicknesses of paper have been applied; then press and smooth the whole with the fingers and allow this to dry, when the mask may be turned out of the mould. Give the mask a coat of white oil paint, adding a little venetian red. To make this, get ½ lb. of white lead, a little boiled oil and turps, and a few drops of gold size, adding then the tint of Venetian red. When dry, the mask may be applied as wished, and the front part of the mask is complete. A barber's block should now be used for the back part. Get a stout piece of white linen canvas, place the selvedge edge over the centre of the block to lay 1 in. over the front half of the mask, then crease it and cut to fit the block, of course leaving it large enough to pass over the head. Glue the overlapping parts together and glue together the front and back of the mask. A piece of tape may be run in at the neck to draw it to the head. The canvas should be painted to correspond with the front. Rabbit skin or wool may be glued on for the hair, but if a bald head is required add a little copal varnish to the paint.

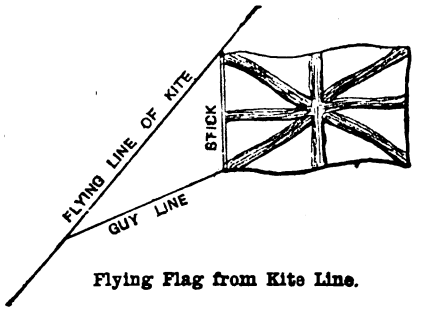
Metallic Soaps.—Metallic soaps are obtained by double decomposition. First a soap solution is produced and heated to boiling point. An equally strong solution of the metallic salt (preferably a chloride or sulphide) also is boiled, and the two boiling solutions are mixed together, the metallic soap obtained being gathered on a linen cloth. The soap is dried on enamelled plates, first at 104° F. (40° C.) and later at 140° F. (60° C.). Aluminium soap is the most important metallic soap. Dissolved in benzine or oil of turpentine, it is an excellent varnish for waterproofing linen, cloths, paper, leather, etc. The compound has been recommended for weather-proofing railroad ties. Manganese soap and zinc soap are used as siccatives in the preparation of linseed oil varnish, as well as paint driers. Copper soap enters into the composition of gilding wax, and is used for bronzing plaster-of-Paris articles. For this latter purpose copper soap or iron soap is melted with white lead varnish and wax. Iron soap is used with aluminium soap for waterproofing, and in the production of a waterproof varnish. By substituting wax for the soap, insoluble metallic soaps are obtained, and these impart brilliant colourings to oils and waxes if melted in them; coloured waterproof and weather-resisting varnishes may also be produced with them. Metallic resin soaps may be produced by double decomposition of potash resin soaps and a soluble metal salt. From these, good varnishes are obtained for waterproofing paper, and also they may be employed as floor waxes or lacquers.

Paint or Varnish for Foundry Patterns.—Pattern makers use for coating their work a red varnish having a brilliant gloss so as to give the pattern a smooth surface; this enables the pattern to slip easily out of the mould, and also prevents the pattern from absorbing moisture, and thus shrinking, swelling, and warping. The varnish may be prepared as follows. Place in a revolving churn 10 lb. of shellac, 7 lb. of spirit copal gum, 5 gal. of methylated spirit, and 1 gal. of fusel oil. Allow the churn to revolve until the gums have dissolved; then dissolve 4 oz. of spirit aniline (orange) in 1 qt. of methylated spirit, and place in the churn and again revolve until the whole is thoroughly mixed; after being run through a fine sieve the paint is ready for use.

Waterproofing Paper.—Strong grey paper made from hemp may be rendered waterproof by immersion in a solution of pale shellac 5 lb., borax 1 lb., and water 20 lb., after which it is run through large rollers to remove the surplus liquor. The paper is then placed in a room heated to 100° F., after which it is packed ready for use. A simple method of waterproofing thick hemp paper is to immerse it in a hot solution composed of resin 25 lb., paraffin wax 22 lb., and silicate of soda 5 lb. This preparation leaves a hard and smooth surface quite durable and waterproof when exposed to the weather.

Lacquering Tin.—The following is a recipe for a lacquer that will give to tin the colour of brass. Take 3 oz. of seedlac, 2 dr. of dragon's blood, and 1 oz. of turmeric powder, and place in 1 pt. of well rectified spirit. Allow to remain thus for fourteen days, but give the bottle a shaking up at least once each day. When thoroughly well combined, strain the liquid through muslin. The tinware to be coloured must be dipped in dilute acid to remove all dirt and grease, and dried in warm sawdust, when it is ready for the lacquer to be brushed over it in the ordinary way.

Flying Flag from Kite Line.—To raise, by means of a kite, a flag so as to make it spread well out to the wind, tack it to a light stick or lath and tie the upper end to the kite line. Then attach a cord two or three yards long to the bottom of the stick and knot it to the line lower down, as shown in the sketch. The distance of the flag from the kite will vary with the size of the former as



Flying Flag from Kite Line.

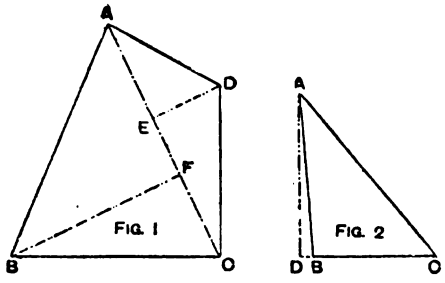
compared with the latter, and the steadiness of the wind. A tandem of two or three small paper kites would easily support a good-sized flag up in the air; it is advisable to get the first kite up a bit, say a couple of hundred yards or so, and the second half that distance. With fine line and the kites at a good height so as to be inconspicuous, a flag of moderate dimensions would present the curious appearance of floating in space without any visible means of support.

Limes for Optical Lanterns.—Lime cylinders for lantern use are either turned in the solid or moulded. For the moulding of lime cylinders, slake perfectly white pieces of quicklime with a little water so as to form a dry powder; wash this several times with clean water, allowing it to settle out, and pour off the clear water each time. Then dry the powder until it crumbles in the hands. Now compress it in an iron cylindrical mould that tapers very slightly towards the upper end, and has a loose bottom with a rod in the centre and a plunger for pressing. On forcing out the loose bottom of the mould the lime cylinder will go with it. The lime cylinder should be dried first at ordinary temperature, and then at a gradually increasing heat, until finally it is made white hot in a furnace. As the lime contracts considerably in heating, the mould should be made larger than the finished cylinder.

Neapolitan Mandoline.—The shell pattern Neapolitan mandoline, in shape resembling a cocoanut cut lengthwise, varies greatly in the number of its ribs. Common instruments generally have nine ribs only, which are stained in two colours, whilst best quality instruments may have twenty-seven ribs. In some instruments these ribs are fluted. A body of light-coloured woods as maple is considered to give a better quality tone and does not so readily show scratches. The face should be of clean white pine, very even in the grain; there should be seventeen frets and eight strings arranged in pairs, operated by means of machines similar to those used on guitars. The joints should be accurately made and good quality glue used. The manufacture of mandolines cannot be undertaken without the aid of accurately shaped moulds on which to bend the ribs; these must have been previously cut to shape, using a brass or zinc template. To secure the correct contour of these moulds, a cheap class instrument should be purchased and taken part, thus ensuring correct measurements as well as shape. An instrument of medium quality should be attempted before taking in hand an expensive one. A modification of the Neapolitan mandoline is an instrument of American make. The mandoline-banjo is fretted and played exactly as is a five-stringed banjo. The mandoline-guitar is tuned and played like a guitar; both have the tone and timbre of a mandoline, and have flat backs similar to a guitar, but are much smaller in size, and in construction are much easier to make than a shell-back instrument.

Removing Stains from Celluloid Collars.—A yellowish stain appears on celluloid collars, etc., after they have been in use for a short time, and it is doubtful whether this can be effectually removed; celluloid does not allow water to penetrate it, therefore the outer surface only will be affected. The best bleaching agent is chloride of lime. Take 1 lb. of this, and make it into a paste with a little water; add sufficient water to make up to 1 gal.; steep the articles in this for several hours, then remove and steep in several changes of clean soft water.

Determining Sail Area of Model Cutter Yacht.—In calculating the sail area for a model cutter yacht, first the mainsail is drawn to scale in inches, say ¼ in. to the foot, and a diagonal A C (Fig. 1) is drawn



Determining Sail Area of Model Cutter.

through the corners. Lines at right angles to A C are drawn to D and B. Then $\frac{A C \times B F}{2}$ = area in inches of A B C, and $\frac{A C \times E D}{2}$ = area in inches of A D C. The results, added together, give the total area of the mainsail. For a triangular sail, a line is drawn from the apex A to cut the base B C (Fig. 2) extended to D; then $\frac{A D \times B C}{2}$ = area of A B C in inches. The rating of a model yacht is found by the following expression. $\frac{\text{Length on water line} \times \text{sail area.}}{6{,}000}$

Liquefying Air.—Air and other perfect gases are: liquefied under the combined action of pressure and cold. The latest method of liquefying gases acts principally by what is known as the "self-intensive" process—that is, the air is submitted to high pressure, and in the condensed condition it is allowed to pass out of a narrow tube into a wider one. In so doing the air expands and removes heat from the vessel around which it is circulating. Inside the inner vessel the same process is going on. The air in the very centre of the apparatus, being submitted not only to high pressure, but also to the intense cold produced by the alternate compression and expansion of the air in the outer jackets, is rapidly liquefied, and falls down into a glass tube, which is surrounded by an iron jacket. Rather more than 500 cub. ft. of air are required to produce 1 cub. ft. of liquid air.

Ferro-prussiate Paper for Photographs.—The following are instructions on making ferro-prussiate paper. Make 25-per-cent. solutions (or 1 part of the solid to 3 of water) of (*a*) citrate of iron and ammonia, and (*b*) potassium ferricyanide or red prussiate of potash. Mix equal quantities of the solutions immediately before use, and apply to the paper with a tuft of cotton-wool or a Blanchard brush. Dry the paper quickly, and print till a deep blue image results. Ferro-prussiate paper requires a longer exposure than silver papers. As the paper is sensitive to light, all the operations of preparing the paper and drying it should take place in the dark room.

Choosing Concertina.—An English concertina, an instrument such as made by Jefferies, Wheatstone, Lachenal, or Roylance, having four rows of keys on each side, allows of a wider range of tones than the Anglo-German makes. The arrangement of keys and method of holding the instrument by thumb straps enable the performer to play extended harmonics without having to stretch the hand. The notes are so arranged that those in spaces are usually on the right side, those on the lines on the left; the two middle rows are the naturals, whilst the two outer rows give sharps and flats. The instrument has a range of four octaves, embracing the treble clef and capable of playing music as arranged for the flute and oboe, or other treble instrument. Its tones blend with a piano that is kept in tune to Broadwood's medium pitch, which is also the pitch of most high-class concertinas.

Burnt Alum.—Powdered burnt alum as used by taxidermists for skin preserving is prepared from the potash alum, not the common or ammonia alum. Place a quantity of this in an iron ladle and heat it over a Bunsen burner or perfectly clear fire, when the alum will froth up considerably; the heating must be continued till the frothing ceases. The light, friable material is burnt alum; after being powdered it is ready for use.

Leather Punching Ball.—In cutting the sections of leather for making a punching ball find the centre of each section by folding the leather from A to C (Fig. 1) and from D to B. Cut the leather from A to B; fold A to C and cut B C as A B. This should make half the section

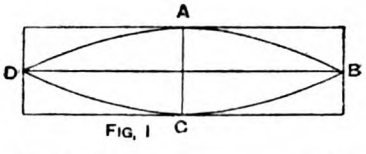


FIG. 1

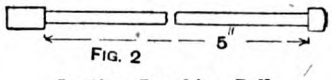


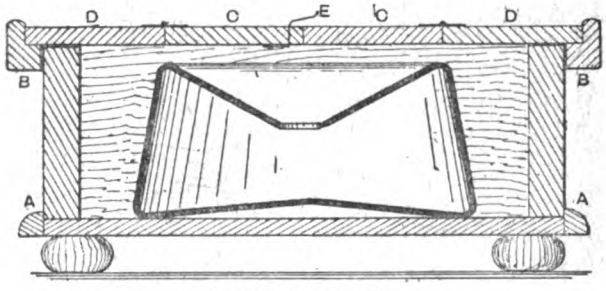
FIG. 2

Leather Punching Ball.

hard soap is then melted over a fire and poured into the mixture with the varnish. It is then allowed to cool down, when it is thinned to the consistency required by mixing in more naphtha. For any other colour than slate use suitable pure pigments having a good body or strong staining power. It dries hard, with a bright surface, and is a good preservative against weeds, barnacles, etc.

Cleaning Stereoscopic Photographs.—Stereoscopic photographs are produced by many different processes, and one method of cleaning would not apply to all. Any method of cleaning will disturb any handwork on the print, but if such work is only spotting it can easily be restored. For an albumen print, use a little warm soapy water rubbed very lightly over with a tuft of cotton-wool. A gelatine print may be rubbed over vigorously with encaustic paste on a silk handkerchief, or even white curd soap may be used dry in the same way. Greasy matter can be partially removed by rubbing with benzene or methylated spirit. Platinum or plain salted prints can be cleaned with an ink eraser.

Spittoon Footstool.—A spittoon, even although it may be a convenience, is scarcely considered an ornament in a room, and good taste suggests its concealment; the illustration shows a method of disguising it as a footstool. The outside measurements of the box are 11 in. by 9 in. by 4 in.; its ends are ¾-in. board, and all other parts about ½ in. thick when planed. The box is mounted on four feet; these are shown turned, but they may be made octagonal, and so cut by hand, each being fixed with a couple of screws. Round the bottom of the box should be fixed a ½-in. moulding A. The top—that is,



Spittoon Footstool.

correct. Fold the leather again, bringing B to D, and cut A D C as A B C; this should give a correct section. The rubber cord is joined to the strap attached to the ball by reducing the circumference of the rubber. Commence ½ in. from the end and reduce by about one-half; continue this for about 5 in. (see Fig. 2). With a three-cord, well-waxed thread bind the part that has been reduced; then fold it over to form an eye and strongly bind the two parts together. The strap can be passed through the two eyes at the ends of the rubbers and buckled up to any size required. If the thread slips when binding, the rubber should be covered with thin tape treated with solution and firmly fixed before binding with thread.

Cutting Paper for Photographic Prints.—Printing-out paper is usually folded and cut or torn to the size required, an ivory newspaper knife about 8 in. long being used. Of course, the bench on which the paper is laid should be covered with clean paper or calico. Cut platinum paper with shears, and allow for after-trimming. Paper stretches the long way of the sheet. As a rule, for portraits the paper is cut so as to stretch the shorter way of the print, but when the face is too fat the paper may be cut to stretch in length. By cutting the paper as the occasion may demand, thin faces may be made to look fatter and fat faces thinner. For the majority of prints the way the paper is cut is immaterial. The fingers must be kept scrupulously clean, the sensitive side of the paper touched as seldom as possible, and perspiring hands should be constantly wiped dry.

Anti-fouling Paint for Bottoms of Yachts.—For a slate-colour anti-fouling paint for yacht bottoms, take 14 lb. of plumbago, 14 lb. of French chalk, 3 lb. of arsenic (white), 8½ lb. of common resin, 14 lb. of zinc white, 1 gal. of oak varnish, 4 lb. of hard soap, and 9 gal. of Pratt's deodorised naphtha. Place the chalk, arsenic, zinc white, and plumbago in a tub; melt the resin in a suitable vessel, cool down to 100° F., and slowly add the naphtha, stirring all the time. Pour this mixture in the tub, well stirring during the operation. The

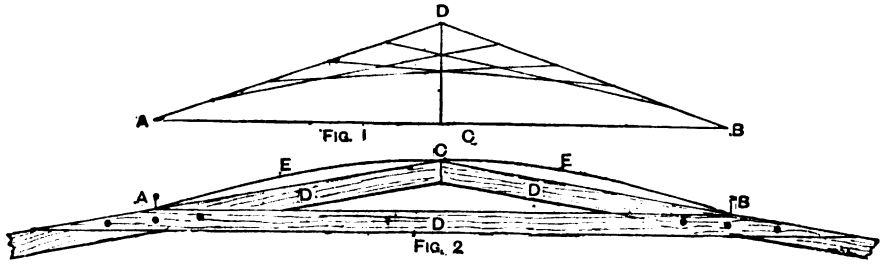
all above the side uprights—lifts off bodily for the removal of the spittoon when necessary. It consists of four strips B of ¾-in. board, 1 in. wide, mitred at the corners, and fitting easily over the box. In these strips is cut a rebate to receive the pieces D on which the lids C fold. The lids are hinged to D, and, when folded back, exactly cover them. A small slip of leather passed through a slot at E, and fixed by a couple of tacks on the under side, serves for opening the lids. The sides and top of the footstool may be covered with cretonne, and the feet and strips A and B ebonised.

Timing Sewing Machines.—It may be taken as a general rule that the needle and shuttle of a sewing machine start together—that is, the shuttle must have reached the full extent of its backward movement when the needle-bar is at the bottom of its travel, and as soon as the needle-bar commences to rise, the shuttle should start to move towards the needle. If a revolving-hook machine gets out of time, the point of the hook should be a little behind the needle, say, roughly, ⅛ in., and when the point of the hook has reached the needle, the eye of the needle should be about ¼ in. below it. The theory is, that the needle should be able to move sufficiently to throw out a loop of cotton for the shuttle point to enter before the shuttle reaches it. If it is not possible to let the needle and shuttle start together, let the needle have just a little start.

Painting and Decorating Organ Pipes.—In painting organ pipes they should be given two coats of white paint made from genuine white lead, driers, pale boiled oil, and turpentine. When thoroughly dry they should be flatted with No. 0 glasspaper. The colours for painting must be ground in turpentine, care being taken to see that they are pure and extremely fine. They should be mixed to the required consistency by adding turpentine and pale gold size in the proportion of 5 of the former to 1 of the latter. Two coats of the paint will be found sufficient. Mixing in this proportion will prevent the paint peeling off the pipes. This mixture comprises what is called the self-bound and dead surface paints.

Composite Candles.—The original composite candles were made by adding stearic acid (stearin) to tallow, and, instead of dipping the wicks in the melted material as for the old tallow candles, the wicks were placed in moulds and the material poured into them. When paraffin wax became an article of commerce, it was used in place of tallow, and the composite candles were then made of from 80 to 90 per cent. of stearin and from 10 to 20 per cent. of paraffin wax. Owing to the fact that paraffin wax makes a fine-looking candle, the amount of this material has been increased to from 85 to 95 per cent., and only from 5 to 15 per cent. of stearin is now used.

Striking Out Patterns of Sweeps for Cant Board.—The base lines of all broughams, landaus, etc., are true sweeps so far as the body is concerned. In a brougham the sweep is true from the hind corner pillar to the front standing pillar; and in a landau, from back elbow to front elbow, which is termed the elbow or top quarter line. One method of making such sweeps is shown by Fig. 1. Draw a horizontal line A B; at C draw a vertical line twice the height of the required sweep to D. From A to D and D to B draw straight lines; space them out as shown and intersect them, when the inner lines will give a true sweep. Fig. 2 shows another method of making the sweep. Mark off the length A B; at C, which is the height of the required sweep, insert a panel pin or wire nail; also insert pins at A and B. Then get three laths D, butting two together at C, fixing them by the bottom lath close to the pins put in at A and B. Having the laths long enough to reach to the end of the sweep, with a pencil held at the top of the laths at C, push the frame around, keeping it close up to the pins, and describe the lines E, which will be found true and correct. Sweeps are usually made in sets of twelve for coachmaking, some workmen using the old-fashioned 3-ft. length, whilst a great many prefer a 4-ft. length, which will take in a quarter and door of a brougham or landau.



Striking Out Patterns of Sweeps for Cant Board.

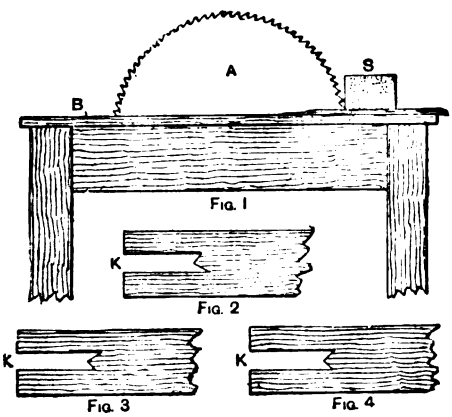
Flow of Water from Catchment Area.—A catchment area that is flat exposes more surface to evaporation than an area that is in the form of a valley with steep sides, and the yield of water with the same amount of rainfall will be less in the first case than in the second. The greater the amount of inclination in the surface of a catchment area, the greater, other things being equal, will be the proportion of water delivered from a given rainfall, for the water flows down the sides of the hills into the stream at the bottom before the ground has had time to absorb any great quantity of moisture. The fact may also be noted that districts where hills and valleys abound are the districts where the greatest rainfalls occur. Permeability of surface in a catchment area has an important effect on the yield of water. Where the surface of the ground is rocky and impermeable the whole or the greater portion of the rainfall flows off into the stream and is delivered to a reservoir built to receive it. A permeable surface absorbs more or less of the rainfall, and slight rainfalls may be totally absorbed by the soil and not affect the quantity of water collected. If the surface only of the ground is absorbent (the formations below the surface being impermeable), the bulk of the water that is infiltrated may crop out lower down the hillside in the form of springs, and ultimately, some days after the rainfall, will be delivered into a reservoir built in a suitable position. If the area had a bare rocky surface, water would only flow into the reservoir immediately after rain, and after a few days' drought no supply of water would be received from the catchment area. Where there is a permeable subsoil the direction in which the strata incline is a matter of importance. Sometimes a permeable layer of subsoil falling towards the catchment may bring a supply of water from a distant area beyond the limit of the valley in which the water outcrops. On the other hand, if the permeable strata fall away from the sides of the catchment area the strata may intercept and carry off a great deal of water from the storage ground, thus diminishing the yield that might reasonably be expected from the rainfall.

Sand.—Sand, says A. C. Passmore, is the term applied to any mineral substance in a hard, granular form, such as the schistose, granitic, and calcareous rocks, freestone, etc., which have been reduced to a granular state by spontaneous disaggregation or by the agitation of water; sand is insoluble in water, and has grains of an appreciable size. It is distinguished from powders by at once falling to the bottom when thrown into water, without discolouring it or altering its transparency to any considerable extent. Sand is found strewn upon the surface of the earth, in strata at certain depths, or forming the beds of rivers or shores of the sea. Sand may be divided into two classes, "siliceous" and "calcareous"; but it is more particularly denominated according to the nature of the predominant constituent, as siliceous sand, iron sand, etc. The siliceous sands are pit sand, river sand, and sea sand. By examining the particles composing sand the source from which they are derived can easily be ascertained. The schistose rocks produce a sand with lobular-shaped grains, which are very tender and soon reduced to a powder when washed by rains and currents of water. The granite rocks produce a sand composed of grains of felspar, mica, and quartz; whilst volcanic rocks furnish lavas of all kinds. The fossil sands are found deposited in situations where now neither brooks nor rivers flow; they generally have a more angular grain than sea or river sand, but consist mainly of the same constituents. A sand belonging to the fossil order is the arene sand; it is generally quartzose, and composed of very irregular and unequal grains; it is found mixed with clay in proportions varying from one to three fourths. The calcareous sands are the least common, and are produced from oolitic stones or rocks; they are not susceptible to what may be called granitic disaggregation, as if they belong to the hard variety they produce scaly splinters or laminar grains, whilst if they be of the soft variety they produce powder. Generally speaking, the use of calcareous sands yields a much stronger concrete or mortar on account of their porous nature, but they are not so good if absolute watertightness is desirable. Portland cement and crushed sandstone is 55 per cent. stronger than a similar quantity of Portland cement and pit sand.

Removing Grease Stains from Paper.—Grease stains may be removed from paper by thoroughly moistening the stained parts of the paper with benzene or petroleum spirit; on this lay a piece of clean blotting paper, and over this run a warm iron. Repeat treatment if necessary.

Terpeneless Oil of Lemon.—Terpeneless oils are prepared by distillation from essential oils. The raw oils consist of limonene, flavouring matters, and stearoptenes. The flavouring matters, consisting principally of ethers, are the most valuable. To obtain them in the pure state the oil is heated under reduced pressure with a dephlegmating column until all the limonene has passed over; on cooling the residue in the retort, the stearoptenes, which were kept in solution by the limonene, now separate out, leaving a fine essential or terpeneless oil. Terpeneless oils are more useful than ordinary oils for mineral water manufacture, but the yield is extremely small, and therefore their price is very high. It is a usual plan to make an essence by dissolving 1 part of the ordinary oil in from 6 to 15 parts of spirit of wine; enough of this essence is added to the sugar syrup and is in this way disseminated through the aerated water.

Packing and Grinding Circular Saws.—The packing of a circular saw, provided that the saw is loose or slack near the rim, should be arranged to heat the plate a little at the centre, so as to equalise the tension in the saw-plate. A saw that is slack at the centre should be packed less tight, and if very loose or slack it should be packed a little warm near the rim. After a certain amount of work, all circular saws become more or less slack at and near the rim owing to the extra traverse and friction at that point, when more or less heat should be conveyed to and near the centre of the saw by means of the packing. Often saws are said to require hammering, when the trouble might be overcome by proper packing. It is preferable to wrap the hemp round strips of wood, but previous to this remove all chips from the hemp, as these tend to cause undue friction on the saw-plate. Occasion arises when the packing has to be placed on a flat surface (the table of the saw-bench) and hammered. If leather is used, the hammering is apt to stretch the leather in places, hence it becomes lumpy, and the heat, not being properly distributed on the plate, is very likely to cause trouble. The best way to grind off the points of circular saw teeth, so as to get each tooth to do equal duty, is to cut a little way into a piece of wood about ¾ in. thick, and then to place a piece of medium hard grindstone S (Fig. 1) on it, and immediately in front of the saw teeth on the bench B. Hold the stone firmly while the saw A revolves, so that it just touches the points of the teeth. When all the teeth points have been ground by the stone, the saw will be round. The grinding should be carefully done, the pressure being brought against the points very gently. The teeth should now be filed until the flat places caused by the stone disappear; file alternate teeth from one side, then the remainder from the other side of the saw-plate. After grinding, and previous to sharpening, examine the saw kerf made in the wood by the saw teeth. A kerf K as in Fig. 2 shows that the outside range of teeth are high. A saw in this condition will draw (as it is termed) thick, and becomes very much heated, and subsequently crippled. If the saw kerf is as Fig 3 the saw will draw thin in the cut. A saw properly rounded and sharpened should present a kerf as shown in Fig. 4. If properly packed, with plate true, of proper gauge, and evenly set, this saw should make a true cut.



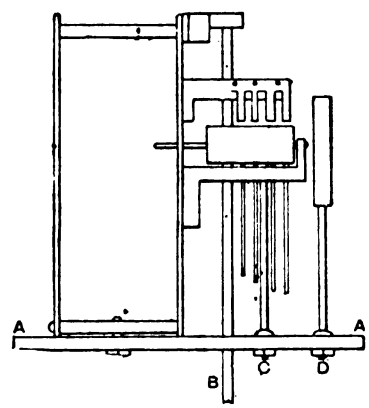
Packing and Grinding Circular Saws.

Brass Pins for Watches.—Small brass pins as used for fastening the hairspring and plates of watches are filed up from brass wire with the aid of a pin vice and a block of hardwood in which shallow grooves are made. The pin vice is held in the left hand between the forefinger and thumb and caused to revolve, while the brass wire rests in a groove on the wood. A fine file is used, and the pins are smoothed with a flat burnisher. They should be made to a gentle taper.

White Paint for Steam Gauges.—A great many steam gauges are stove-enamelled and rubbed down with fine powdered pumicestone and water. A paint may be prepared as follows. Take 2 lb. of pure zinc oxide paint, stiff, ½ gal. of pale japan gold size, 1 lb. of beeswax, and 3½ gal. of American turpentine. Mix the zinc with the turps slowly, so as to get a uniform mixture, then add the gold size, and finally melt the beeswax in a small quantity of the turpentine and add slowly to the mixture, which must be constantly stirred during the whole operation. It should then be placed in a hot-water bath, which causes a thorough mixture of the ingredients. Before using, run it through a fine sieve. The mixture should be applied as ordinary paint; four coats will be found necessary, care being taken to have the work well "flatted" after each coat. It dries hard in about twelve hours, and has an eggshell gloss.

Removing Oil Stains from Books.—The following method may be tried of removing some colza oil that has been spilt over a book and causes the letterpress to show through from each side of a leaf. Lay a sheet of blotting paper on each side of a leaf and gently rub a hot iron over it. By this means some of the oil will be removed. Continue this treatment for a considerable time. Another method is to get some benzine and wash the leaves, using cotton-wool. This treatment should not be carried out near a fire or in a very hot room. If the book is badly saturated with oil the task is hopeless. It may be possible to remove the greasiness, but it will be impossible entirely to remedy the transparency of the leaves.

Gongs for Grandfather Chime Clock.—The sketch herewith shows the arrangement of gongs for a grandfather chime clock. A is the seat board, B the pendulum rod, C the quarter-gong standard, and D the hour-gong standard. These clocks require very deep cases. Next to the movement comes the pendulum and crutch, taking up 1 in. Behind that is the standard supporting the four quarter gongs, taking up 1¼ in. At the back of all is the hour gong, requiring 1 in., so that there must be at least 3¼ in. from back-plate to back of case. All the above measurements are the minimum.

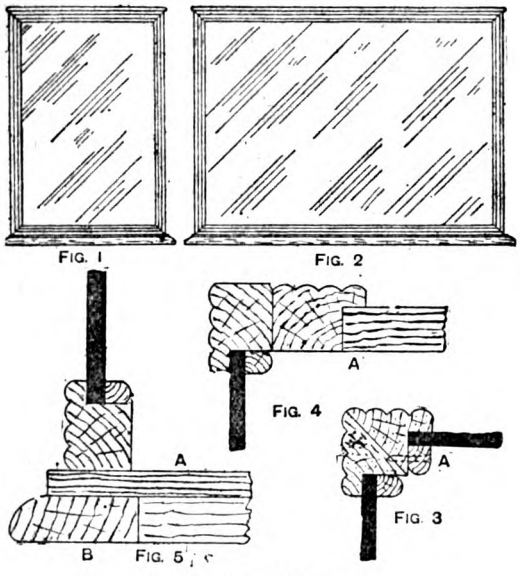


Gongs for Grandfather Chime Clock.

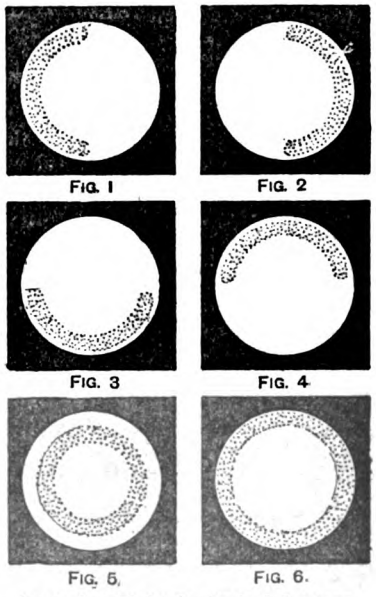
Dyeing White Cotton Drill Navy Blue.—Indigo is the only dye that will produce a fast blue on cotton drill. As the indigo is not directly soluble in water it is necessary to make up a vat containing reducing agents which reduce the indigo to indigo white, which is easily soluble. The vat is made up of water 1 gal., indigo blue (real) 1½ oz., sulphate of iron (copperas) 3 oz., and dry slaked lime 3½ oz.; for larger quantities corresponding proportions are used. These materials must be well mixed together and raked up from time to time; the vat is in proper condition for dyeing when of a brownish colour and covered with a blue scum. The twill should be boiled with water to remove any sizing and weighting material, and then placed in the indigo vat either by unrolling it from a frame and drawing it through the solution, or by fastening it to a wooden frame for dipping, the object being to thoroughly wet the material evenly with the dye liquid and thus prevent the dye laying on unevenly. When the whole of the cloth has been through the vat, allow it to remain in contact with the air for a short time, then pass it in again and again; finally spread it out in contact with the air for the blue to develop. Before dyeing, always remove the blue scum from the surface of the bath. After the blue colour is fully developed, pass the article through a dilute sulphuric acid bath—1 part acid to 100 parts water—to brighten the colour; then wash in clean water and hang up to dry. The indigo blue is insoluble in water; it is brought into solution as indigo white by the reducing action of the copperas and lime, and is again oxidised and rendered insoluble in the fibre by exposure to air. The colour is perfectly fast to washing and to sunlight.

Saddler's Black Wax.—For a saddler's black wax melt in a pan over a slow fire till thoroughly amalgamated ½lb. of pitch and ½lb. of resin, stirring slowly the while, then add about half a pennyworth of boiled linseed oil, and pour a small quantity of the mixture into a bucket of cold water. Allow to stand for half a minute, then pull the mixture hand over hand; if it sticks well together without cracking or breaking, it is right as to softness, but if it cracks and breaks, put in more oil; if too soft, add more resin or pitch. If the mixture is of the desired consistency, pour it all into the cold water, and pull it hand over hand till it floats on the water; cut a small piece and throw it in to try. Add more or less oil (or tallow will do), according to the weather.

Case for Stuffed Animals.—A case for small stuffed animals may be made from solid reeded oak or walnut picture-frame moulding about ¾in. wide; three frames are made, two for the ends (Fig. 1) and one for the front (Fig. 2). Mitre the frames together at the angles as shown by Fig. 3, and if a solid back is desired, a smaller frame may be fitted in as shown at A (Fig. 4), a panel being used to fill it up instead of glass. The bottom of the case may



Case for Stuffed Animals.



Centering Light in Optical Lantern.

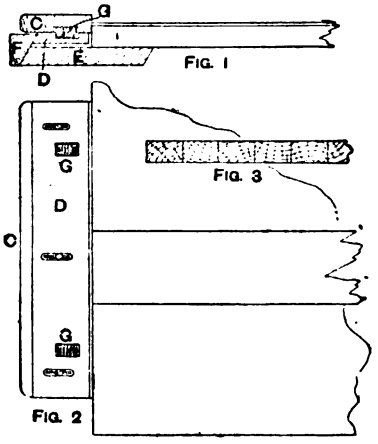
be of the same stuff as the mouldings, but about ¼in. thick, and may stand over the edge of the frames ¼in. all round; see A (Fig. 5). Below this, pieces B 1½in. wide by ¾in. thick, moulded on one edge, are mitred round the edges to form a bottom for the stand. The top may be made of a panel about ¼in. thick, with the edge rounded and projecting ¼in. all round. The glass may be fixed in with beads as at A (Fig. 3), and if the case is to stand on a table where the animals can be seen all round, the back and top of the case may be mitred in as shown for the front corners in Fig. 3, and filled in with glass instead of panels. The corners may be put together with hot glue, but the bottom should be secured with screws with the heads underneath the case; the bottom may be covered with baize, or mounted on short turned legs. For a good background for the back of the case, saw up a piece of elm bark, and, after covering the surface of the wood with glue, sprinkle over it the bark sawdust.

Use of Air-vessel in Pump Suction Pipe.—The so-called air-chamber on a pump suction pipe, after it has been used for a short time, so that some of the air is exhausted, is partly filled with air in a state of tension, and partly filled with water held up by the partial vacuum that varies according to the movement of the pump bucket and the depth from which the water is being raised. Such a chamber is advantageous when fixed on long suction pipes, as, for example, when the pump is situated at a considerable distance from a well. In a suction pipe without an air-vessel the water stops and starts in sympathy with the movement of the pump bucket or piston, but with an air-vessel the tension of the confined air tends to keep the water in the suction pipe in motion during the downward movement of the bucket. This air tension also causes water to flow into the chamber, and thus forms a small reservoir, which is drawn upon, thus avoiding the necessity of increasing the speed of travel of the water in the suction pipe. In the absence of the air-vessel an excess of effort is required to overcome the inertia of the water in the suction pipe at the commencement of the stroke, and if the pump was worked too vigorously probably a vacuum would be created beneath the bucket; and the water would knock against the bucket after a short interval of time.

Centering Light in Optical Lantern.—An unevenly illuminated disc on a screen results when the spot of incandescent lime, from which the lantern condenser gathers the light rays, is not perfectly central, both horizontally and vertically. In getting the jet quite central, light up as usual, and focus the disc until its edges are sharp; adjust the position of lantern so as to get the disc in the centre of the screen; probably now the disc is unevenly lighted. If it resembles Fig. 1, the lime is too much to the left; if Fig. 2, it is too much to the right; if Fig. 3, it is too low; and if Fig. 4, it is too high. When the disc resembles Fig. 5, the lime is central, but too close to the condenser; when it resembles Fig. 6, the lime is still central, but too far from the condenser. The happy medium is obtained somewhere between the conditions represented by Figs. 5 and 6, and is an even field of light. Vertical and left-to-right adjustments are made by loosening the clamping screw on the pin and again tightening when the defect is remedied. The distance between the light and the condenser is altered by moving the whole jet together with its tray. The shaded portion of the sheet will not be so well defined as in the accompanying illustrations, in which the effect is exaggerated.

White Metal Motto Rings.—Very common German silver or brass is generally used for cheap motto rings. A punch on which is engraved the motto will be required. A shaped wire half round one side and half oval the other, similar to the section of a wedding ring, should also be procured. This wire will require to be stamped with the motto tool in lengths, each length being equal to one ring. When ready, cut off the lengths containing each motto, trim the edges, and bend round on a small taper mandrel and solder. Trim off the solder, and either dip or electro-nickel the rings, or else boil them white. The whitening operations may be done by boiling the rings for two or three hours in a long copper trough containing crude cream of tartar with tinplates carrying a layer of rings. The whole charge is composed of alternate layers of rings and tinplates, so that each layer of rings is between two tinplates.

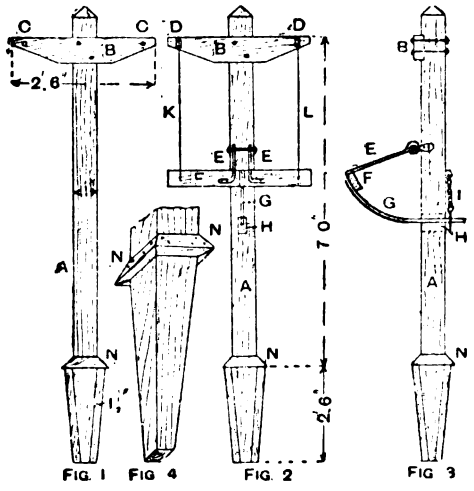
Drawing-board Attachment.—The drawing-board attachment shown by Figs. 1 and 2 holds the T-square firmly against the left-hand edge of the drawing-board in any required position, leaving the draughtsman's two hands free. It does not prevent the T-square being used at the bottom of the board if required to draw a long vertical line, but in practice it is generally more convenient to keep the T-square always in position at the left hand of the board, using a large set-square for vertical lines. The simplest way to make the dovetailed groove in which the stock slides is to build it in two pieces, as shown in section at Fig. 1, where E represents a bar of hard wood 4½ in. broad and ¾ in. thick screwed across the under side of the left-hand edge of the board. On the outer edge of this bar a fillet F, bevelled at 60°, is fastened with screws, forming a parallel dovetailed groove. The piece D is of the same length as the stock C of the square, 1½ in. broad and ¼ in. thick, and is fitted to the bevel on F, and screwed to the stock with three screws, the screw-holes being slotted for a ½-in. travel as shown in the plan of the under side (Fig. 2). The springs G are made of No. 18 B.W.G. hard steel wire; they are 1 in. long and ⅝ in. external diameter, containing ten complete turns, leaving fully $\frac{1}{16}$ in. between the turns. The recesses in D to contain the springs are ½ in. long, $\frac{1}{16}$ in. wide, and just over $\frac{1}{16}$ in. deep; these grip the springs slightly, and this saves trouble when putting together. The spring recesses in the stock are just 1 in. long, but otherwise are



Drawing-board Attachment.

the same as before; it must be observed that the position of the recesses is such that the stock will overlap about $\frac{1}{16}$ in. on the board when the springs are at rest, as shown at Fig. 1. It is better, in the first instance, to give too much pressure than too little, as a paring out of the proper end of the recess in the stock will adjust the pressure to what is required. A little grease under the heads of the screws will allow them to slide freely in the slots. In order to allow the board to rest evenly on the table another bar may be screwed to the right-hand edge of the board. The bars should both be fastened with slotted screw-holes so as to allow the board to come and go a little with the weather. If the bars are held rigidly to the board at all points, the result will be a hollow or a round on the face of the board according as the weather is wet or dry. A description of a large board that remains flat may be helpful. Strips of yellow pine 2 in. by ¾ in. are glued edge to edge; the joints are plain, and made with thin glue well rubbed out, and will never give trouble although used on a board 5 ft. by 3 ft. 6 in. The secret is that each alternate strip as it is cut from the board is turned upside down, the consequence being that when exposed to heat or moisture each piece tends to cast in a different direction to its neighbour, the result being that the board as a whole keeps perfectly flat. Fig. 3 gives a section of several pieces of the board, the reversal of the grain being shown by the rings. Even if all the pieces are not taken from one board, the rings will be a guide as to the jointing.

Clothes Line Fixture in Yard.—The illustrations show a simple pole and pulley device for fixing a clothes line. Fig. 1 is a view of the post to which the ends of the line are fixed; Fig. 2 explains how the lines run over the pulleys; Fig. 3 is a side elevation of Fig. 2, showing the arrangement for tightening the line; whilst Fig. 4 shows the end of the post with fillets. The two posts A are movable, being made to fit into oak sockets sunk in the ground. 6 in. from the top of each post is bolted a cross-piece B, which is cut ½ in. into the post for extra stiffness. The cross-piece in Fig. 1 has a hole bored near each end to which to secure the clothes line C. The cross-piece in Fig. 2 has a pulley D let in near each end for the line to run over. About 2 ft. below the top of the cross-piece B in Fig. 2 are fixed irons E, on the ends of which is fixed the cross-piece F, and in the middle of this, between the two irons E, is screwed the quadrant G. A mortise is made in the post through which the end of the quadrant can pass, as shown by dotted lines at H (Fig. 3). This end of the quadrant must be pierced, at intervals of about 1 in., with ¼-in. holes, to receive an iron pin secured to the post by a short chain (see I, Fig. 3). The manner of fixing and tightening the clothes line is as follows:—Pass one end of the line through one of the holes C (Fig. 1), and tie a knot at the back; then pass it over the corresponding pulley D (Fig. 2) and down (as at K) through the cross-piece F, then along F and through the hole at the other end, up (as at L) over the pulley D, back to the cross-piece B (Fig. 1), and through the hole C, where it must be knotted again. When fixing the line, the swinging cross-piece F should be high enough to bring the top irons E nearly horizontal, and

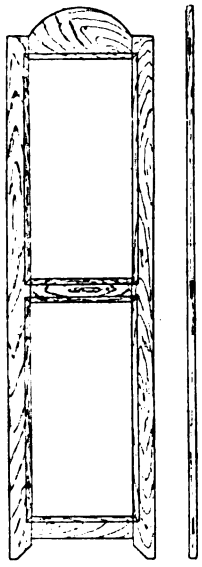


Clothes Line Fixture in Yard.

the quadrant G nearly out of the post; then, when all is fixed, on pressing down the cross-piece F, both the lines will be drawn tight and, by inserting the pin I in the quadrant, will keep so. The posts must be placed in the sockets so that the line pulls the top cross-pieces towards them instead of having a tendency to pull them off. Nail oak fillets round the posts, so as to rest on the top of the sockets N, and fit blocks to the sockets for use when the posts are removed, to prevent the holes getting filled with stones or dirt.

Reducing Dense Photographic Negative.—A negative may be reduced very easily by either of the methods given below, but the operation must be carefully performed so that reduction may take place evenly and not go too far. Soak the plate so that it may be evenly wetted. While the plate is soaking, make a small quantity of a 10-per-cent. solution of potassium ferricyanide. This solution does not keep satisfactorily and must be made as required. Take sufficient of clean fixing bath to cover the plate, and to each ounce of the bath add a few drops (say ten) of the ferricyanide and immerse the negative. If reduction does not commence in a few moments add a drop or two more of the ferricyanide. When the negative is sufficiently thin, wash for ten minutes and dry. An alternative method is to place the negative to soak in a 5-per-cent. solution of ferric chloride (perchloride of iron) for one minute and transfer to a clean hypo bath; if the negative is insufficiently reduced, wash and repeat the operation. If the negative is hard, a solution of ammonium persulphate may be used; but in the case under consideration the solution already recommended will be the most suitable. A few experimental attempts on some worthless negatives may, perhaps, save a good negative from being hopelessly ruined, because a negative that is reduced too much cannot be restored again.

Four-fold Screen.—The accompanying diagram shows a back and side view of a simple frame arrangement of one of the panels of a four-fold draught screen. The wood may be about 2½ in. by ¾ in., and, if the cloth is only stretched over the front of the screen, it would be well to see that the joints are properly made, and also, since two panels will be shown at the back on account of the centre rail, to have these bevelled as illustrated. This, besides making the back more presentable in appearance, will give a finish to the panels and so make it possible to ornament them as well as the front. If the whole face of each panel is to be painted, the frame should be covered with artists' prepared canvas. As there are no keys on the frame—as with the stretchers used by artists to keep their canvases tight—it is advisable to damp the cloth before nailing it down. It will then contract in drying, thus ensuring a tight and firm surface. The canvas should be cut sufficiently large to fold over the edges of the frame. The best way to fix the canvas is to nail it with tin-tacks along one of the long edges of the frame first, and then to stretch the cloth as tight as possible over the opposite edge and tack it down. The top and bottom are then fixed in the same



Panel for Four-fold Screen.

way. Since the edges of the frame will be seen, it is better to secure the canvas permanently by brass-headed nails placed close to each other. These nails are put in after the canvas has been fixed with tacks, the tacks being withdrawn and the nails inserted. The back of the canvas, being rough and unsuitable for painting on, must be given a coat of whiting and size, or faced with one or two coats of oil paint. The exposed parts of the frame may then be stained a dark walnut colour. If it is only intended to paint sprays of flowers on each panel without covering the whole surface, silk or satin or any strong cloth may be used instead of canvas. If cloth of an open texture is used, it is advisable either to size the places where the paint is to be applied or to squeeze out the colours on a sheet of blotting-paper instead of on the palette. The blotting-paper will absorb a small portion of the oil, and so prevent a stained appearance on the edge of the painting. Suitable prints, which may be adapted to the size required, can be obtained from any dealer in artists' materials.

Silk Fishing Gut.—When making silk fishing gut, in the spring procure from a naturalist some silkworm's eggs and place them in a cardboard box in the sun. Feed them on mulberry leaves or, if these are not available, lettuce leaves, keeping them well supplied and cleaning out frequently. When about the length of the little finger they turn a dull colour; then stop feeding, and prepare to spin. When these symptoms appear they are thrown into hot vinegar, and about twelve hours afterwards pulled asunder, the effect of which will be to draw the matter from which the worm spins silk into three or four strands. These are stretched on pins driven into a board and allowed a few days to harden, when they are put into a bath of soap and soda to remove the scale. The strands are then hung in a warm room to dry and afterwards polished with washleather. The gut must now be soaked in strong alum water to remove grease, and then stained with strong tea, coffee, or blue-black ink.

Warming Greenhouse with Oil Lamp.—As a rule it is not profitable to heat a greenhouse with paraffin oil, but an oil lamp as shown by Figs. 1 and 2 is very useful in a small greenhouse in the autumn and early spring for keeping out damp and frost when chrysanthemums are in bloom and half-hardy annuals are being raised. The fumes from the chimney will do no harm if the roof light is opened slightly, and if the atmosphere becomes too dry inside the greenhouse, the lid A (Fig. 1) may be taken off and replaced with a metal bowl that may be filled with water. The apparatus may be made as follows. A square or round tank B, capable of holding about three pints of water, is made of stout tin, or a pressed beef tin or small paint drum would serve the purpose. Two ½-in. holes are made through the side C, and a 1-in. hole is drilled through the bottom. A lid is fitted to the top with a 1-in. hole in the centre, and a tin tube D passed through from the bottom, this being carried about a foot above the top of the lid to form a chimney. The bottom and lid joints are secured with solder. A

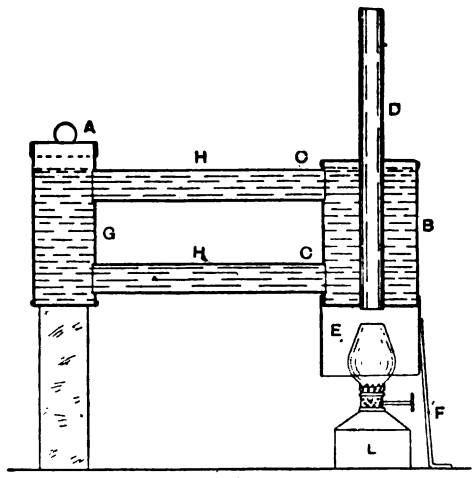


FIG. 1

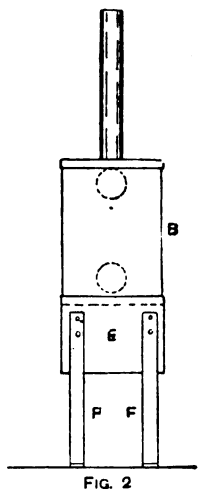


FIG. 2

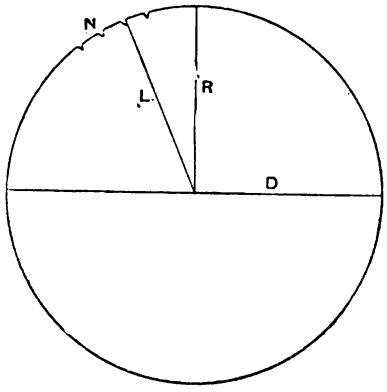
Warming Greenhouse with Oil Lamp.

flange E about 4 in. deep is soldered to the bottom of B, as shown, and two hoop-iron legs F are riveted outside this. A smaller tank G is fitted with a loose lid A for the purpose of filling with water, and two holes are made in one side to correspond with those in the larger tank. Two tin tubes H about 1 ft. 6 in. long are made by bending over a round rod and soldering at the joint to form flow and return pipes, these being soldered into the two tanks as shown. The apparatus is filled with water through A, G being supported by a brick, and a lamp L is placed under B. A pint of paraffin oil per day is about the quantity required to warm a greenhouse 5 ft. square. The lamp is cleaned daily, and with care the heater will last three or four seasons. A conical tube through B gives greater heating surface, but is difficult for an amateur to make.

Gum Dragon or Gum Tragacanth.—Gum tragacanth or gum dragon is an exudation of the tree Astragalus, which grows in Persia. The gum is found in two forms, leaf gum and stalk gum, the latter in long thin sticks. It is of a dull, grey colour, much resembling camphor; when digested in water it swells considerably, forming a gelatinous mass. After it is boiled the whole combines to form a thick mucilage, when a change takes place, and a great portion of it separates. It is soluble in alkaline solutions and ammonia, and is insoluble in alcohol. The powdered gum dragon is often adulterated with common varieties of gum arabic and flour of starch. The former may be detected by adding a few drops of alcoholic tincture of guaiacum, and then well agitating; if the sample contains any gum arabic a blue tint will gradually appear in the mass. Gum dragon is used by shoemakers, confectioners, and calico printers, for thickening purposes.

Sizing and Varnishing Shop-window Tickets.—For fixing the writing on shop-window tickets, thoroughly mix together 1 part of white hard spirit varnish and 8 parts of methylated spirit, and steep or pour this solution over the ticket; this will prevent the colours from running. This preparation is usually sold under the name of Fixatif; it does not discolour the articles, as it is perfectly colourless. The tickets should then be sized with a solution consisting of ½ lb. of pale gelatine size and 1 pt. of boiling water; this also is colourless. Finally, coat with transparent spirit or pale French oil varnish. The spirit varnishes are chiefly used for paper tickets, whilst the oil varnishes are used for those that have to withstand all weathers. Both the above varnishes are colourless, and will not discolour white.

Determining Tooth Pitch in Circular Saws.—In determining the pitch or lead in re-toothing circular saws, draw a diameter as D on the saw-plate (see sketch), then draw a radius R at right angles to D, and a line L indicating the required lead. If the teeth are to be cut down by means of an emery wheel, this should be set so as to grind the face of the teeth to the angle shown. When one tooth has been cut down a little, cut the next, and so on until all the teeth have been cut. The wheel being set to the proper angle, the lead in each tooth will be precisely the same. When on an emery wheel, the teeth should not be cut down to their full depth at once; each tooth should be gone over two or three times until the required depth is obtained. Notches made in the plate with a file, as at N, indicate

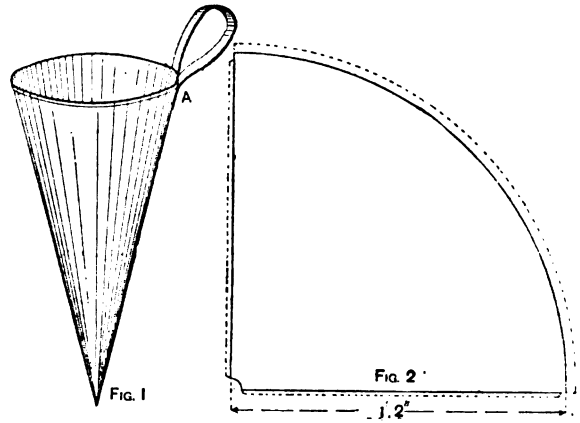


Determining Tooth Pitch in Circular Saws.

the space between the points of the teeth. After a little practice the index on the machine will be a guide in setting the wheel to a suitable angle for teeth in saws of any diameter, or for doing any kind of work.

Fixing Photographic Negatives.—When a photographic plate (which consists of a sheet of glass thinly and evenly coated with gelatine containing particles of white bromide of silver) is exposed to light the silver bromide may be assumed to have changed to silver subbromide, which by the aid of a reducing agent or developer is changed to metallic silver. Portions of the plate that have been protected from the light still consist of the unchanged sensitive silver bromide, therefore a fixing agent must be something that is capable of dissolving and removing this unaltered silver bromide. The fixing agent must, however, be incapable of attacking the metallic silver forming the image. Thiosulphate of sodium ($Na_2S_2O_3$) fulfils these requirements. (Thiosulphate of sodium is better known as hyposulphite of soda or "hypo," though the real hyposulphite is a different compound, its formula being Na_2SO_2). When a plate is placed in a solution of thiosulphate of sodium, silver thiosulphate is first formed ($2AgBr + Na_2S_2O_3 = Ag_2S_2O_3 + 2NaBr$), and afterwards a double salt of silver and sodium ($Ag_2S_2O_3 + 2Na_2S_2O_3 = Ag_2S_2O_32Na_2S_2O_3$), which is soluble in water. With the formation of this double salt the opalescent appearance of the plate disappears. There are, however, two double hyposulphites of silver and sodium, namely, $Ag_2S_2O_3Na_2S_2O_3$ and $Ag_2S_2O_32Na_2S_2O_3$. The former of the two is practically insoluble, and the latter is the one that must be formed; therefore a large excess of hyposulphite is necessary. At the same time, too strong a solution must not be used or it will be unable to penetrate the film, and too strong a solution will be slow in action; 4 oz. to 1 pint of water is a good strength. The fixing bath should be made with warm water if for immediate use, because the solution becomes very cold as the soda dissolves. A better plan is to keep the bath made up as a saturated solution and dilute it as required. This plan also permits of a slight precipitate. The solution will keep a considerable time, but if the solution is old it should be tested with litmus paper. If the solution shows acidity (by turning the blue litmus red) a few drops of ammonia should be added until the colour returns to the test paper. The fixing bath for negatives may be used several times, but the bath should be discarded directly it works slowly. Old fixing baths are very rich in silver, which may be precipitated with liver of sulphur; but the silver is scarcely worth saving unless precipitation on a large scale is carried out. The explanation given above of the action of the fixing bath shows that the plate should not only be left in the bath till the opalescent appearance has disappeared from the plate, but that a further period of time equal to that already allowed should be permitted to elapse before the plate is removed from the bath.

Sheet Copper Ale-warmer.—Fig. 1 represents an ale-warmer which can be made from a sheet of No. 24 B.W.G. sheet copper. The first operation is to tin one side of a piece of copper, from which the pattern (Fig. 2) can afterwards be cut. Block tin, with sal-ammoniac as a flux, is preferable for tinning; but failing this, tinsmiths' solder, with killed spirit as a flux, will make a good substitute. It is better to tin rather more copper than is



Sheet Copper Ale-warmer.

required for the pattern, as otherwise the tin would collect at the edges of the pattern and make them thicker than is desirable for working purposes. The pattern is practically a quadrant, which, when turned, will be twice as deep as it is wide, and will contain rather more than ¼ gal. The dotted edges are for the seam and a wired edge at the top; those for the seam are folded in opposite directions, and the pattern is then turned to shape over a sharp funnel stake, after which it is grooved. The seam is soldered down from the inside; the wiring edge is set off outwardly, and folded over a ring of No. 10 B.W.G. tinned wire. The point or apex is flattened and folded twice, and then riveted to the sides of the ale-warmer. Then float a small body of solder inside to render it perfectly sound. A handle A (Fig. 1) can be made by cutting a strip of copper sufficiently long to make the required loop and 1¼ in. wide. This is edged and wired along the length edges, bent to shape, and riveted in position. The outside can be cleaned with crocus and oil, and finished with dry crocus powder; use whiting for cleaning the inside.

Removing Paint from Golf Balls.—The paint can be readily removed from old golf balls by dipping them for a few minutes in warm caustic soda solution—1 part of soda to 10 parts of water—and scrubbing. Instead of caustic soda, 2 parts of dry carbonate of soda and 1 part of quicklime may be employed; dissolve each separately in 10 parts of water, and mix. After the paint has been removed the balls must be thoroughly washed.

Colourless Gum Solution.—Gum arabic is the palest gum that is soluble in water. Buy a good quality of gum, and pick out the white pieces. If the solution when made is not absolutely white, warm it with a little powdered animal charcoal, stirring well all the time, then filter through a flannel bag until it is clear and bright.

Ballast or Burnt Clay.—Ballast (or burnt clay), says A. C. Passmore, is an excellent substitute for sand in the making of mortar and cement, but it must be thoroughly burnt. The clay, after being dug out, is exposed to the sun for several days, and is then heaped up over a fireplace roughly formed with bricks and intermixed with coal. A fire being lighted in the fireplace, the clay must be thoroughly burnt, the pieces being afterwards ground to a size similar to grains of sand. Ballast is used even in high class work with satisfactory results.

Making Van Wheels to Track.—Below is described the correct method of setting out the wheels of a van so that they track. To get at the length of the axle beds A (Figs. 1 and 2), find the pitch or lay-out of the wheels; this is governed by the amount of dish in them, as it is customary to set a face spoke at the under side of the wheel square up from the ground line. To get the pitch, mark in the height of the wheels B (Fig. 1), also mark off the felloes and stock, then draw in the spokes C (Fig. 1). From D, on the face of the spoke mark off the dish of the wheel, 1¼ in.; draw a straight line from the bottom felloe through the point E, going to the top of the wheel; this is the pitch line of the wheel, the dotted lines representing the tyres. From the bottom spoke, mark in the length of the stock F (Fig. 1) both back and front, parallel with the pitch line. Mark in the top spoke, to give the position of the wheels, then make an outline of the body as G (Fig. 1), leaving a space of 6 in. between the inside of the wheel at the top and the side of the body. Then square off a distance of ¾ in. from the back of each stock; this will be the length (4 ft. 3½ in.) of the

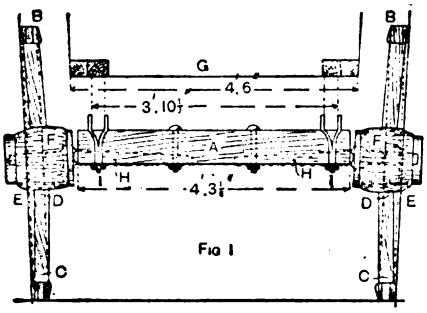


Fig 1

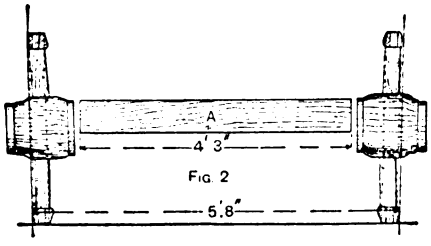


Fig. 2

Making Van Wheels to Track.

axle bed required (see Fig. 1). The axle arms H (Fig. 1) are let in as shown by the dotted lines, and, when they are in place, their centres should be perfectly square with the pitch lines E. In letting in the axle arms, keep them ¼ in. below the axle bed; this will allow them to be well screwed home by the spring clip coupling I (Fig. 1), and also provides room for any slight easing required to get the correct pitch. To test the wheels, when letting the arms in, slip the wheels on with the axle bed upside down, and hold a large square board on the axle bed and against the face spoke; it can then be seen whether the wheels are correct or not. To get the length of the front axle bed, proceed as with the hind one, setting out the width of the track, 5 ft. 8 in.; it will then be seen that to run on this track the front axle bed requires to be ¼ in. shorter than the hind one on account of the difference in the pitch of the wheels. This only applies where the stocks are all one length, as sometimes the front ones are shorter than the hind ones, for which allowance has to be made.

Increasing Drying Qualities of Varnish.—Carriage body varnish, to make it dry quickly, is placed in a suitable vessel and warmed until it becomes thin; then a small quantity of palest japan gold size (½ pt. to 1 gal. of varnish) is added. It is mixed thoroughly and allowed to cool before using. Care must be taken not to add more than the above quantities, or the varnish will crack and lose its brilliance. To ensure success, the varnish should be applied very thin.

Painting Whitewashed Ceiling.—For painting a plaster ceiling that has been whitewashed several times, first it is necessary to wash off all the old distemper right to the plaster. Coat the ceiling with hot size (7 lb. of size to 1 gal. of boiling water), and then wipe over with a sponge which will drive the size into the air cracks and prevent "mapping." Now give the ceiling three coats of paint, the first two coats consisting of equal parts of white lead and zinc white ground in oil and thinned with equal parts of raw oil and turpentine. The last of the three coats of paint should consist of zinc white only, thinned with pale varnish if a bright finish is required; if a flat finish, thin with turpentine only. No driers are required, the zinc being a drier.

Furnaces for Varnish Making.—Furnaces for varnish manufacture vary considerably in construction, each maker having his own methods and ideas on the subject. The furnaces for gum running are constructed below the floor of the varnish house, the top of the furnace being on a level with the floor. The furnaces, built of the best white firebricks, are usually 2 ft. by 3 ft. by 3 ft., and are fired from the outside. A large iron plate 3 ft. 6 in. square and ¾ in. thick, with a hole in the centre to admit the bottom of the gum pan, covers the top of the furnace. A copper flange round the bottom of the pan supports it over the hole in the furnace top. A hood over the pan carries, by means of a pipe, all noxious vapours to the chimney. In some factories large pans (of about 120 gal. capacity) are run to and from the fires on specially constructed vehicles running over trolly rails. The oil or set copper used for finishing the varnishes holds about 300 gal., and is set in much the same way as an ordinary washing boiler, the only difference being that the finest firebricks are used in construction. Beneath the furnace a trough holding about 30 gal. of water should be constructed; the wet ashes are used for slaking the fire when the desired temperature is reached. When the fumes are overpowering, provision should be made for stirring the copper from outside the building, and this can be done by making a hole in the wall above the copper, and covering the hole when not required with an iron slide 30 in. square, which may be pulled up and down as required. The copper should be provided with a sheet-iron lid worked on hinges and raised by a thin iron chain over a runner above the copper and fastened near the outlet or door so as to be easy of access in case the contents of the copper should ignite.

Backing for Photographic Plate.—The most reliable backings for photographic plates all contain caramel, but ordinary burnt sienna mixed with office gum may be used, or even the sienna alone. This sienna must of course be ground in water. Old carbon tissue that has become insoluble may be wetted and squeegeed into contact with the glass side of the plate; this old tissue makes a good backing. Plates may be obtained ready backed at the same price as ordinary plates, and will be found better than the plates backed at home.

Colourless Varnish for Whitewood Fretwork.—To make a colourless varnish suitable for whitewood fretwork, take 4 oz. of bleached, commonly called white, shellac, crush it small, and spread out on clean paper till perfectly dry in a warm room. Place the shellac in a jar or glass bottle with 2 oz. of best amber resin and ½ oz. of gum mastic, and add 1 pt. of methylated spirit. Set aside in a warm place, frequently agitating till well dissolved, then carefully strain through muslin into another clean bottle. A camel-hair brush is used for applying the varnish to the articles, which should be set aside in the warmth to dry. Owing to the porous nature of some woods, several applications may be necessary in order to gain a bright level surface; allow at least an hour to elapse between each application.

Moulds for Golf Balls.—A mould for a golf ball is in three pieces: an outer ring of polished metal slightly taper inside, a loose bottom with a hemispherical cavity representing half the ball, and a plunger also with a corresponding cavity. The guttapercha is put in whilst in the plastic condition and moulded by applying pressure to the plunger. It would be found an advantage to have a hand press, to which the plunger could be attached; this would give considerable pressure, and, moreover, the work would be done in much less time.